East Fork Jemez River

Stream Inventory Report

Santa Fe National Forest
Jemez Ranger District
Surveyed July to September 2001
Forest Fisheries Crew

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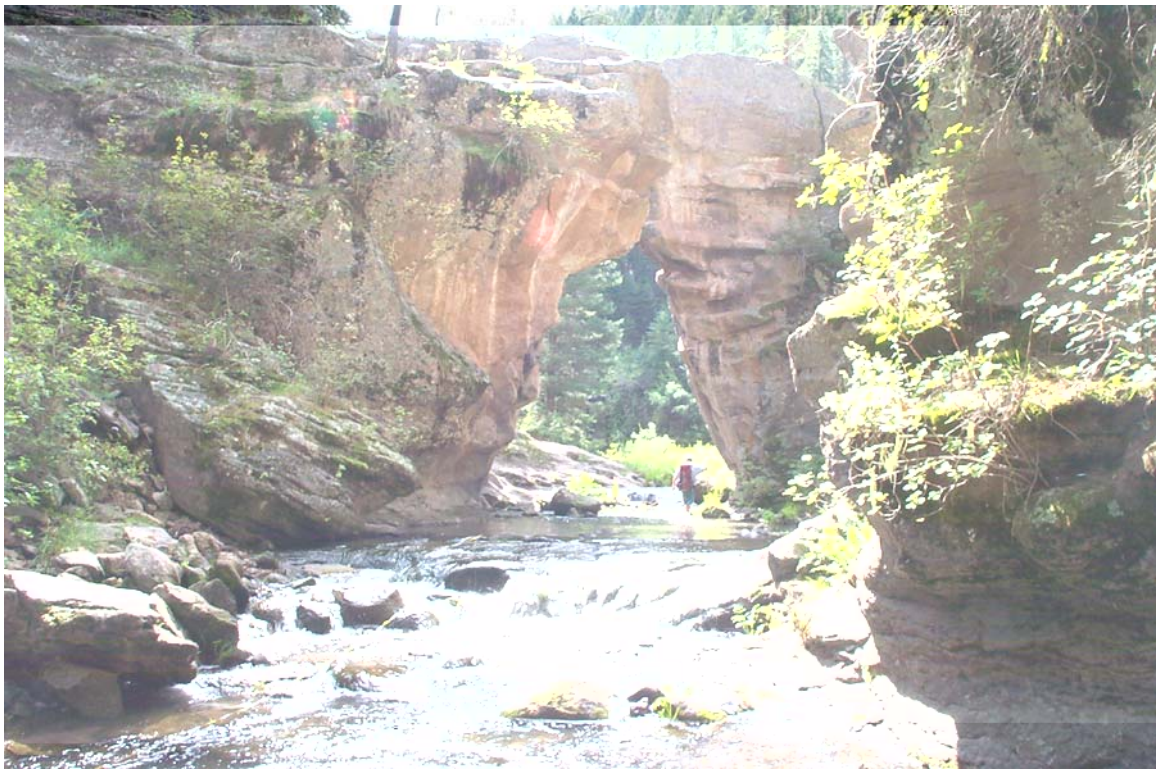

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Map of the East Fork Jemez River Watershed

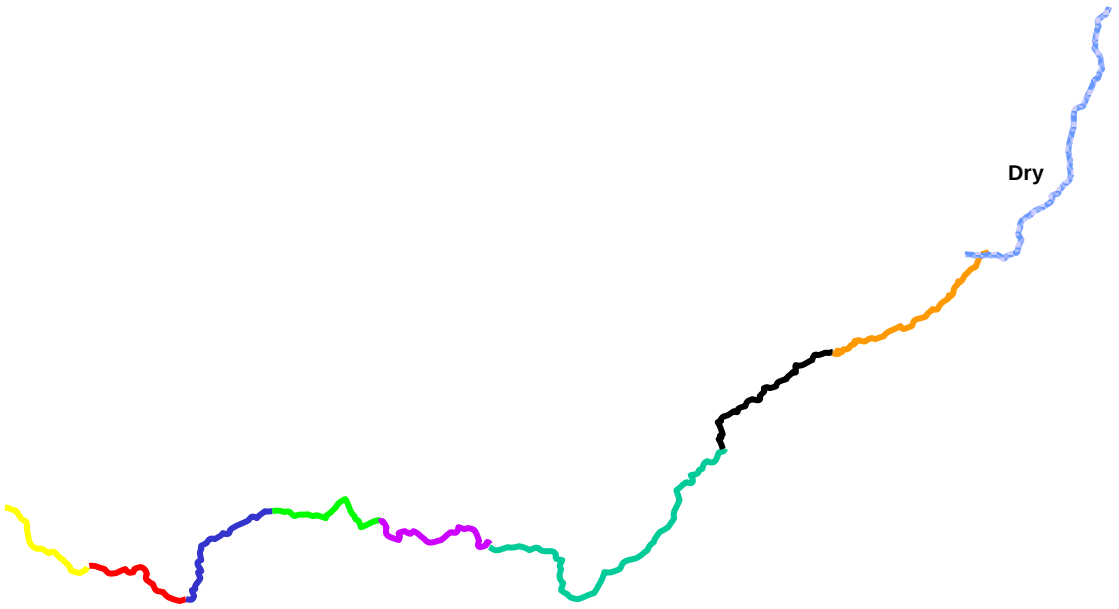


Figure 1. Map of the East Fork Jemez River Watershed and its 8 reaches.

Introduction
East Fork Jemez River 2001 Stream Survey

The Santa Fe National Forest Fisheries Crew conducted a stream survey on the East Fork Jemez River during the summer of 2001. A total of 21.43 miles of stream were surveyed, from the mouth (Township 19N Range 3E Section 32 at 6755' Elevation) to the headwaters (8523'Elevation) where the East Fork Jemez River starts at a group of springs. The East Fork Jemez is a 4th order tributary to the Jemez River. The East Fork Jemez River and San Antonio Creek come together at Battleship Rock to form the Jemez River (See map on proceeding page.)

A modified Hankin/Reeves stream inventory methodology (Region 6) was adopted by Region 3 and was utilized for this survey. Stream habitats were broken up into riffles, pools, side channels, dry channels, culverts, and falls and given a Natural Sequence Order number (NSO). In addition, tributaries, such as streams, seeps and springs, were inventoried and given an NSO. The NSO that calculated stream length were riffles, pools, culverts, and falls. The other NSO units were used to calculate available stream habitat, not stream length. This stream habitat survey specifically catalogues aquatic habitat. The PFC survey conducted by the Santa Fe National Forest determines hydrologic function and condition.

Other Measurements and Estimations Recorded

Measurements	Estimations
Maximum depth of pools, riffles, and side channels	Average depth of riffles
Depth of pool tail crest	Substrate percentages of bankfull width (Fines, Gravel, Cobble, Boulder, Bedrock)
One bankfull width/depth per reach	Average wetted width of riffles and pools (Each reach a factor of error was calculated by measuring one NSO width everyc
Number of large woody debris within bankfull	
Water temperature during survey	
Water temperature of tributaries	
Water temperature at thermograph sites (Recorded every four hours)	

The main objectives of this survey were to: 1) collect historical information that outlines effects on stream and watershed condition; 2) collect baseline data to determine the quality of habitat and floodplain condition and sources of habitat loss in East Fork Jemez River; 3) identify areas for possible migration barrier construction; 4) identify restoration needs; and 5) determine fish species and distribution.

Basin Summary

Table 1. Stream Summary Table for the East Fork Jemez River.

SURVEYORS:	James Simino, Megan Vogt
FIELD ASSISTANTS:	Jose Marfin, Kristen Behrens
SURVEY DISTANCE:	113160 feet 21.43 miles
LOCATION:	
County:	Sandoval
Forest:	Santa Fe National Forest
District:	Jemez Ranger District
Drainage:	East Fork Jemez River
Tributary to:	Jemez River
Mouth Location:	T19N, R3E, S32
WATERSHED:	
HUC Code:	130202020201
Watershed Area:	129,691 acres 202 square miles
Stream Order:	4
Stream Length:	113160 feet 21.43 miles
AQUATIC BIOTA:	
Fish Species:	rainbow trout, brown trout, cuttbow, Rio Grande chub, Rio Grande sucker, fathead minnow, and longnose dace
Amphibian Species:	tiger salamander, Jemez Mountain salamander, western toad, leopard frog, and chorus frog

Executive Summary

The East Fork Jemez River is a 4th order stream originating from spring sources in the northwest corner of Valle Grande on the Valles Caldera National Preserve (VCNP). Fish use runs from the mouth at the confluence with San Antonio Creek (T 19N, R3E, S32) to the headwater terminus. The East Fork Jemez drains Valle Grande, where it picks up several major tributaries, including Jaramillo Creek and La Jara Creek. From the spring source, the East Fork flows 21.43 miles to its confluence with San Antonio Creek, forming the Jemez River. The East Fork Jemez River is comprised of approximately

130,000 acres located mostly on the Jemez Ranger District (Santa Fe National Forest), in Sandoval County, New Mexico. The upper 9 miles of the river are located on the VCNP, with a small section of private land near Las Conchas Fishing Area. The Forest Service section of the East Fork Jemez River was designated as a Wild and Scenic River in 1990 and is part of the Jemez National Recreation Area (Designated in 1987). The Wild and Scenic River Environmental Analysis and Management Plan will be published in 2002. Activities within the East Fork Jemez Watershed cannot impair qualities related to wild and scenic values described in the EA. This includes activities upstream of the Wild and Scenic Corridor, such as the VCNP.

East Fork Jemez River was broken into 8 different reaches, based on stream and valley morphology and dramatic changes in stream flow. The survey began at the mouth of the river and worked its way upstream. The stream reaches were numbered in an upstream progressive order.

Overall, the gradient on the East Fork Jemez River is extremely variable, ranging from nearly 0% in the headwaters to over 7% in Reach 2 downstream from Jemez Falls. This is atypical; since high mountain streams typically have the highest gradient reaches in the headwaters. However, the headwaters of the East Fork arise on the edge of Valle Grande in the VCNP, a vast low gradient meadow system. Valle Grande arises in the middle of a large volcanic crater. Valles Caldera originated approximately 1.2 million years ago, following the second of two cataclysmic volcanic eruptions that occurred 300,000 years apart from each other. The eruptions ejected more than 100 cubic miles of material. Following the eruptions the center of the volcano collapsed inward, forming the caldera. At one time, the caldera was filled with water, much like Crater Lake, Oregon. Eventually, headward erosion caused by the East Fork Jemez River breached the southwestern rim of the caldera, draining the lake. In 1975 Valles Caldera was designated as a National Natural Landmark (Report on the Study of Baca Location No. 1).

Table 2. Description and Length of Stream Reaches on the East Fork Jemez River.

Reach	River Miles	Landmark at Beginning and End	Land Owner
1	0-1.95	Mouth to McCauley Warm Springs.	Santa Fe National Forest
2	1.95-3.15	McCauley Warm Springs to Jemez Falls	Santa Fe National Forest
3	3.15-5.0	Jemez Falls to NM Highway 4 Crossing	Santa Fe National Forest
4	5.0-6.01	NM Highway 4 Crossing to “The Box”	Santa Fe National Forest and VCNP
5	6.01-7.99	The Entrance of “The Box” to the Exit of “The Box”	Santa Fe National Forest
6	7.99-12.81	“The Box” to Entrance to Valle Grande	Santa Fe National Forest, VCNP, and Private Land
7	12.81-16.51	Entrance to Valle Grande to Confluence with Jaramillo Creek	VCNP
8	16.51-21.43	Jaramillo Creek to Terminus of Headwaters	VCNP

From Reach 8 down through Reach 7, the East Fork meanders through a meadow system, which is broken up by some of the major tributaries such as Jaramillo and La Jara Creek. This meadow system is located where the historic lake once occurred. In Reach 6 the river flows through a mixed canyon meadow system, where it then enters Reach 5, also known as "The Box". This section of the river is extremely confined by a steep canyon mostly comprised of bedrock, which is characterized by numerous bedrock falls and chutes. This is the edge of the ancient caldera. The stream then enters a meadow area surrounded by bedrock walls that continues on downstream to the last road crossing at NM Highway 4. From here to the falls, Reach 3, the river passes through another confined canyon area. There are some falls and chutes in this area, but very little in comparison to Reach 6. Below Jemez Falls, the river passes through a canyon until it joins with San Antonio Creek at Battleship Rock.

The stream is a flashy system. Several times during the summer of 2001 flows would increase dramatically after monsoon events typical to the Jemez Mountains. No irrigation withdrawals or active ditches were found during the survey. Geologically, the East Fork Jemez flows through areas associated with the Jemez Mountains' volcanic origins. The rock in this area consists mainly of igneous formation and includes pumice and tuff. This porous bedrock material and the loss of wetland formation are what make the watershed so flashy. Some obsidian flows can be found in some of the rock formations along the river. Excessive fine sediment loads and high turbidity are found in East Fork Jemez, exacerbated by historic grazing practices. A study in 1997 found that the East Fork Jemez was not in compliance with the high quality coldwater fisheries standards for dissolved oxygen, pH, dissolved aluminum, and total phosphorous (Everett and Hodgins 1991). Further water analysis conducted in 2001 by New Mexico Environmental Department Surface Water Department determined that the East Fork exceeded these water quality standards for a quality cold water fishery; water temperatures on 5/30, 6/14, 7/18, and 8/27/01 below La Jara Creek; pH levels on 5/30/01 through 8/27/01below La Jara Creek; DO concentrations on 9/5/01 above Jaramillo Creek, fecal coliform counts in both the East Fork Jemez and Jaramillo Creek; and turbidity levels on 6/26/01 below La Jara Creek.

Habitat Characteristics

Table 3. Overall Stream Survey Summary for the East Fork Jemez River.

ENTIRE STREAM					
Stream Length Surveyed:		113160 feet		21.43 miles	
Habitat Type	**Total Number**	**Total Feet of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	201	12,507	11.1	10.7	>30%
Riffle	231	98,912	87.4	84.5	-
Culvert	4	379	0.3	0.3	-
Tributary	19	-	-	-	-
Falls	40	1,362	1.2	1.2	-
Side Channel	67	3,907	NA	3.3	-
Total	562	113,160	100.0	100.0	-

During the habitat survey conducted on the East Fork Jemez River, the river was broken up into 562 total NSOs (Habitat Units), which measured a total of 113,160 feet in length. Of these 562 NSOs, there were 201 pools, 231 riffles, 4 culverts, 19 tributaries, 40 falls, and 67 side channels. There were no stream length measurements for tributaries, as they did not contribute to the habitat in the main stem of the river.

Table 4. Matrix of Factors and Indicators of Stream Health Condition for Historic and Occupied Rio Grande Cutthroat Trout Streams as Related to R3 Stream Habitat Inventory.

FACTORS	INDICATORS	Properly Functioning	At Risk	Not Properly Functioning
Water Quality	***Temperature – State of New Mexico Standards***	<20°C (68°F) (3 day avg. max)	≥20°C (68°F) <23°C (73.4°F) (3 day avg. max)	≥23°C (73.4°F) (3 day avg. max)
	Temperature – Salmonid Development	≤17.8°C (64°F) (7 day avg. max)	>17.8º (64ºF) < 21.1º (70ºF) (7 day avg. max)	≥21.1ºC (70ºF) (7 day avg. max)
Habitat Characteristics	**Sediment**	<20% fines (sand, silt, clay) in riffle habitat. Fine sediment within range of expected natural streambed conditions		≥20% fines (sand, silt, clay) in riffle habitat. Fine sediment outside of expected natural streambed conditions.
	Large Woody Debris[1]	>30 pieces per mile, >12" diameter, >35 feet in length	20-30 pieces per mile, >12" diameter, >35 feet in length	<20 pieces per mile, >12" diameter, >35 feet in length
	Pool Development[2]	≥30% pool habitat by area		<30% pool habitat by area
	Pool Quality	Average residual pool depth ≥1 foot		Average residual pool depth <1 foot
Channel Condition and Dynamics	**Width Depth Ratios by Channel Type** *(utilize Rosgen type and range given if applicable)*	Width/depth ratios and channel types within natural ranges and site potential		Width/depth ratios and channel types are well outside of historic ranges and/or site potential
		Expected range of bankfull width/depth ratios and channel type	***Rosgen Type*** A, E, G B, C, F D	***W/D Ratio*** <12 12-30 >40
	Streambank Condition[3]	<10% unstable banks (lineal streambank distance)	10-20% unstable banks (lineal streambank distance)	>20% unstable banks (lineal streambank distance)

[1] Large Woody Debris numeric are not applicable in meadow reaches
[2] Pool Development numeric are applicable to 3rd order or larger streams
[3] Streambank Condition numeric are not applicable in reaches with > 4% gradient

A matrix of factors and indicators was developed to tie to stream habitat information collected during this survey. The matrix originally was developed in Region 6 (Washington and Oregon), but was modified for mountain streams in the intermountain west and relates to regulations determined by New Mexico Environment Department (NMED). The matrix was further refined to incorporate geology of streams historically occupied by RGCT. The East Fork Jemez River is **not properly functioning** for all of the criteria in categories of habitat characteristics, and channel condition and dynamics, except pool quality and streambank condition.

East Fork Jemez River was comprised almost entirely of riffle habitat. If you look at the pool to riffle ratio, 1:1.2, there are 20% more rifles throughout the entire river. However, the percent habitat is quite different. There is almost 8 times more riffle than pool habitat. For a stream to be properly functioning it must have at least 30% pool habitat. The lack of pool habitat is mostly compounded by low counts in Reaches 6-8. This is attributed to: stream widening, decrease in sinuosity, and sediment input filling in pools.

Table 5. Stream Conditions on the East Fork Jemez River

Factors	Indicators	East Fork Jemez Conditions
Water Quality	Temperature 3 Day Average	**Not Properly Functioning**
	Temperature 7 Day Average	**Not Properly Functioning**
Habitat Characteristics	Sediment	**Not Properly Functioning**
	Large Woody Debris	**Not Properly Functioning**
	Pool Development	**Not Properly Functioning**
	Pool Quality	**Properly Functioning**
Channel Condition and Dynamics	Streambank Condition	**Properly Functioning**

Red= Not Properly Functioning

In the lower reaches, stretches of stream had small amounts of pool habitat. This lack of pool habitat is mostly attributed to the lack of LWD and sediment filling in pools. LWD is instrumental in the creation of pool habitat. LWD assists in the creation of pool habitat by scouring out deep pools in areas dominated by sand, gravel, or cobble substrates. LWD also helps dam up areas and create deep pools. The high gradient of the lower reaches have increased the numbers of pools, but have decreased the length of pools. Because the gradient is so high in these areas, a step pool system is created. The number of pools is high, but the length is naturally diminished. These pools are created by boulders, and tend to be small pocket pools in steep cascade or high gradient riffle habitat. Sediment input from all the bank and upland erosion occurring in the VCNP has greatly diminished pool volume in the East Fork Jemez River. The amount of fine sediment input from the erosion has begun to fill in much of the pool habitat. During the survey, one person recounted that he hadn't been to the East Fork for approximately ten years. During that time, it appeared to him that the pools were becoming shallower. One pool that he used to swim in was too shallow, becoming a riffle.

There are no standards and guidelines for side channel habitat, but having only 3% side channel habitat is very low. A little less than half of the river was meadow habitat, approximately 9 miles. The area of stream in the low gradient, high sinuosity meadow systems should have had much higher amounts of side channel habitat. During the survey, side channels were observed that were no longer active, these channels are also noted on USGS quad maps (Revised in 1993). Due to past grazing practices, these side channels have been converted to dry sites due to channel degradation and loss of meadows. In the non-meadow reaches, another factor of lack of side channel habitat is lack of LWD. In high gradient mountain streams, LWD is a large component in the

construction of side channels. When LWD jams are created in high gradient streams, the water is forced around these debris jams, often creating side channel habitat.

The average length of riffles causes no concern at first. However, once the reach summaries are seen, you will notice that the average length among reaches varies greatly.

Table 6. Summary of Habitat and Substrate Percentages for Riffles in the East Fork Jemez River.

Riffle Habitat Summary						
Reach	# Riffles	Avg. Length	Avg. Width	Avg. Depth	Avg. Max. Depth	
Entire River	231	428.2	17.5	1.0	2.2	
Substrate Summary						
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
Entire River	27.0	24.2	20.0	16.5	12.3	100.0
Properly Functioning Indicators	<20.0	-	-	-	-	-

Orange= Dominant Substrate

The lower reaches have numerous short riffles, while the upper reaches have a smaller number of riffles, but the average length increases dramatically. There were several riffles in reaches 7 and 8 that were close to a mile long. In Valle Grande, there was a lack of quality habitat. The riffles continued for the majority of the length across the valley. These long riffles were broken at features such as side channels or tributaries for ease of estimating substrates, unstable banks, and widths. Valle Grande is truly a nine-mile long riffle with a few pools. An undersized bridge created the most prominent pool (albeit unnatural) feature in Valle Grande. If this bridge was repaired, it is very likely that this pool would fill in with fine sediment.

In terms of habitat characteristics, the average sediment levels in riffles throughout the entire river are far exceeding allowable levels, giving it a **not properly functioning** rating. The amount of fines (sand, silt, and clay) found in the riffles of the East Fork Jemez River is 27%, while the necessary level for a properly functioning stream is <20% fines. The riffles throughout the entire river are dominated by a fine substrate. Riffles are typically dominated by a gravel/cobble substrate. The amount of fine substrate is largely due to the delivery of fines from the Valles Caldera, which was visibly noticeable throughout the survey. The river was very turbid, and at times it was difficult to see the stream bottom. The turbidity began to diminish once the survey entered Reach 8, above Jaramillo Creek.

The East Fork Jemez River was **properly functioning** for pool quality. The average residual pool depth was 2.7', exceeding the properly functioning indicator of 1'. Overall, the average pool was of an adequate size, but the number of pools was far below acceptable levels. An average pool: riffle ratio of 1:1 is acceptable, but having more pools than riffles is ideal. Unfortunately there were more riffles than pools in the entire

river. The East Fork Jemez River had only 10.7% pool habitat, an indicator that the stream is **not properly functioning.** The indicator of a properly functioning stream is >30% pool habitat. The amount of pools began to decline once the survey exited "The Box". The upper reaches, 6-8, were dominated by riffle habitat. There were only 36 pools in the last 13.4 miles of stream (2.7 pools/mile), and 27 of these were in Reach 6. The pool habitat in Valle Grande is extremely low. There are only 9 pools in Reaches 7 and 8, which comprise nearly 9 miles of habitat. This is almost 1 pool per mile of stream habitat. Lack of pools mean limited overwintering habitat and decreased thermal protection.

Table 7. Summary of Pool Habitat and Substrate Percentages in the East Fork Jemez River.

Pool Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
Entire River	201	123.8	21.9	3.4	0.7	2.7	9.3	195	9.0	107	4.9
Properly Functioning Indicators	-	-	-	-	-	>1'		-	-	-	-

Substrate Summary							
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total	
Entire River	26.5	21.0	16.2	16.6	19.7	100.0	

Meadow systems, like Valle Grande, are typically comprised of a meandering riffle system dominated by gravels with long deep pools. Within these pools, the banks are deeply undercut providing habitat for fish, and shading the water from the sun. Due to extensive meandering on the stream bends, deeper pools are found, also with deep undercut banks. However, in Valle Grande, the system has been altered by past grazing practices. The undercut banks have begun to slough off into the stream, and the stream has become wider and shallower. This bank erosion is removing the undercut bank habitat and adding fine sediments to the stream. The fine sediments are then transported downstream, and settle out in the slow moving pool habitats, filling in these deep pools with fine sediments, creating extremely long riffles. In fact one riffle in Valle Grande was measured as 4721' long, approximately .9 miles. The riffles in Valle Grande were three times longer than the average riffle throughout the entire river.

Table 8. Habitat Characteristics for the East Fork Jemez River.

Reach	Pool:Riffle Ratio	Avg. Riffle Width:Avg. Riffle Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
Entire River	1:1.2	16.8:1	8.31[1]	21486 feet[2]	8.7
Properly Functioning Indicators	-	-	>30	-	<10

[1] This numeric does not take into account Reaches 7 and 8, as they are meadow reaches.
[2] This numeric does not take into account Reaches 1 and 2 as they had gradients over 4%

The East Fork Jemez River had 8.7 % unstable banks throughout the entire river. However, this measurement does not include Reaches 1 and 2 in the equation, as the average gradients of these two reaches were greater than 4%. Streambank condition is not applicable to streams with a gradient greater than 4%. The streambank condition of the East Fork Jemez River was **properly functioning**, as the percentage was below the indicator of <10%. However, this measurement does not truly depict the upper reaches of the East Fork Jemez River, as mentioned previously, the Valles Caldera had high amounts of unstable banks, for example, 21% in Reach 7. Some of the middle reaches, like "The Box" and above Jemez Falls flowed through areas with numerous bedrock features; thus had low amounts of unstable banks, decreasing the overall percentage.

The amount of LWD per mile for the entire river was 8.31 pieces per mile. This amount of wood indicates that the river is **not properly functioning** for LWD. A properly functioning stream must have >30 pieces of LWD per mile. There are several factors involved in the low amount of LWD in the East Fork Jemez. First, the geomorphology of the East Fork Jemez River greatly affects the levels of LWD. In a typical stream, there are high gradient reaches in forested areas that add LWD to the stream. These reaches are called transport reaches. The wood falls into the stream, and because it has a high gradient, the wood is transported downstream. Once the gradient decreases, the wood begins to settle into the riparian area or gets caught in bedrock features. These areas are called response reaches. The East Fork Jemez geomorphology is such that the transport reaches are located in the middle and lower reaches, with no response reaches downstream. Typically transport reaches are located in the headwaters with response reaches downstream. Due to this factor, the East Fork Jemez has a low amount of wood that is being recruited into the floodplain, where it is needed. LWD is only being recruited locally.

The second factor in the low amounts of LWD in the East Fork Jemez River can be attributed to fire suppression. Since LWD recruitment is confined to local recruitment, only large disturbance events could increase the amount of LWD recruitment. In the forest type found in the Jemez Mountains, fires are one of the most common disturbance events. Fire suppression has hindered the extent of natural fires, which has reduced the amount of LWD recruitment. Some other disturbance events that might assist in LWD recruitment are: Insect outbreaks, which have been reduced due to insecticide use; windstorms, which are not common in this region; and landslides, which have limited impact on this watershed due to its geology.

Reach by Reach Comparison

The East Fork Jemez River was broken into eight different reaches. Table 8, has summarized the habitat characteristics for each reach and the entire river.

Reaches 2-5 have very low amounts of unstable banks. Reach 1 had a higher amount of bank erosion due to heavy recreational use of this area, as well as natural conditions caused by an unconfined high gradient system. The riparian areas in these lower reaches are well developed and in some cases limit bank erosion. The amount of unstable banks

in the upper reaches is due to historic grazing practices in the VCNP, and heavy recreational use in Reach 6. There is some erosion caused by grazing, primarily around the boundary of the VCNP. Reaches 7-8 should be classic Rosgen E type channels; however, due to past grazing practices, these channels are being converted to C type channels. Undercut banks are sloughing into the channel. Erosion is adding sediment to the stream, filling in the deep glides and pools with fine sediment. The channel has become shallow and wider. This conversion is more prevalent in Reach 7 than in 8. There has been a significant loss in sinuosity as seen in lack of side channels and dominance of riffle habitat.

Table 9. Reach by Reach Summary for Habitat Characteristics for the East Fork Jemez River.

Reach	Total Length (Miles)	% Gradient	Rosgen Channel Type	% Pool Habitat	% Riffle Habitat	% Side Channel Habitat	Dominant Substrate in Pools	Dominant Substrate in Riffles	LWD Per Mile	Bankfull W:D Ratio	% Unstable Banks
1	1.95	5.14	A3	18.2	73.1	8.7	Cobble	Cobble	8.7	23:1	21.2[1]

Tributaries

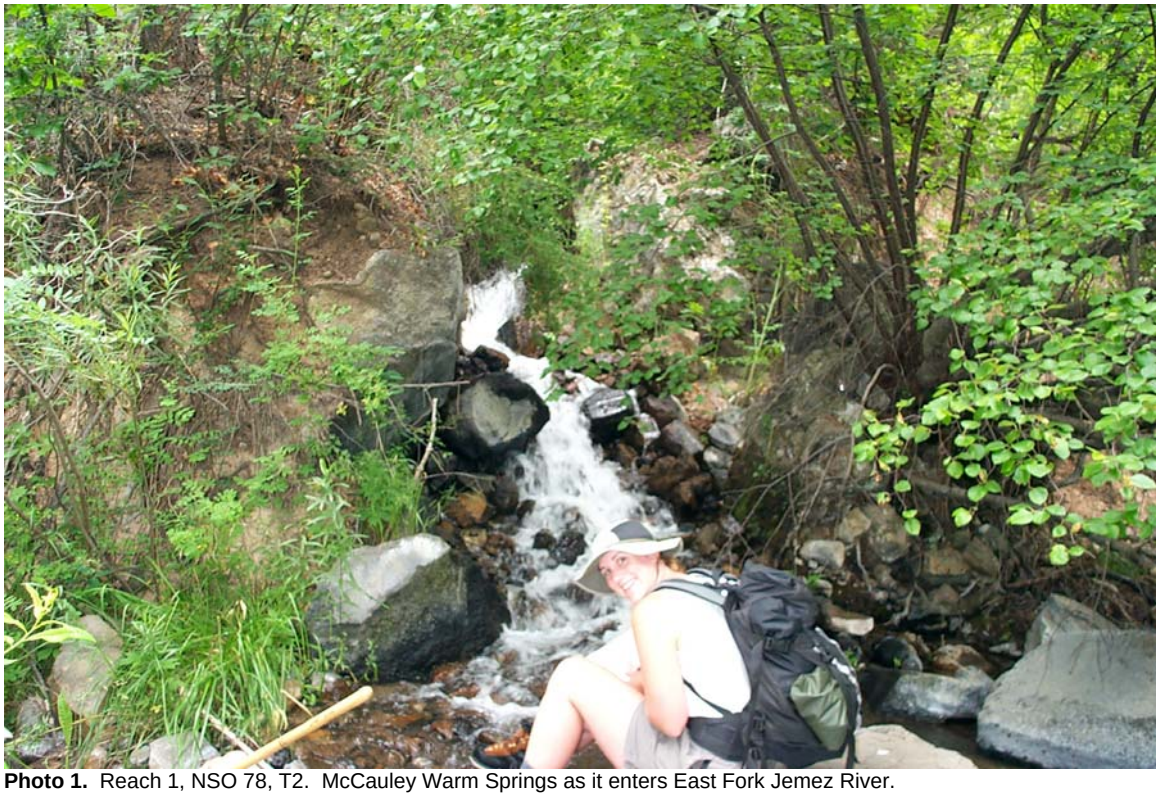


Photo 1. Reach 1, NSO 78, T2. McCauley Warm Springs as it enters East Fork Jemez River.

According to USGS 1:24000 Quad Maps, there are 4 perennial tributaries to the East Fork Jemez River, of which only 2 have official names, La Jara Creek and Jaramillo Creek. Nineteen tributaries were identified on the East Fork Jemez River. Note that seeps and springs are classified as tributaries. The majority of the tributaries were found in Reaches 7-9. Below Las Conchas trailhead, there were only three tributaries over 8 stream miles. Two of these tributaries were warm springs, and the third was a small seep. Yet, the East Fork Jemez was cooler in the lower reaches than it was coming off the VCNP. The East Fork Jemez River is spring fed. With 19 tributaries overall, nine were in the last reach in Valle Grande. East Fork also has two of its major tributaries in Valle Grande, Jaramillo Creek, which comprises 50% of the stream flow; and La Jara Creek, which produces 15% of the stream flow. There is a pond upstream in La Jara Creek, which may limit the amount of water flowing into the East Fork Jemez River.

Table 10. Tributary Summary for the East Fork Jemez River.

Reach	Habitat Number	Bank	Type	Name	Percent Flow	Time	Tributary Temp (F)	Stream Temp (F)	Comments
1	T1	Left	Stream		<5	1405	75	63	Possibly from hot springs. Lots of algae.
1	T2	Left	Stream	McCauley Warm Springs.	<5	1425	79	63	Large waterfall before it enters the East Fork.
3	T3	Right	Seep		<5	1410	64	70	
6	T4	Right	Stream		<5	1252	63	64	Private land between Las Conchas trailhead and fishing area (Cox property).
6	T5	Right	Stream		<5	1415	61	67	Tributary enters river at Las Conchas fishing area. Lots of willows.
6	T6	Left	Seep		<5	0935	57	59	Lots of moss. Dispersed, small seep. Lots of algae.
7	T7	-	Seep		-	1510	-	62	
7	T8	-	Seep		<5	1151	59	60	Lots of aquatic vegetation. Very silty and turbid
7	T9	Left	Stream	La Jara Creek	15	1604	62	62	Lots of aquatic vegetation.
7	T10	Left	Stream	Jaramillo Creek	50	1112	59	58	
8	T11	Left	Seep		<5	1204	60	60	
8	T12	Left	Seep		<5	1205	61	60	
8	T13	Right	Seep		<5	1340	70	56	
8	T14	Left	Seep		<5	1401	62	58	Possible side channel.
8	T15	-	Seep		<5	1535	65	-	
8	T16	-	Spring		<5	1035	57	56	Loaded with new vegetation type.
8	T17	Left	Spring		5	1041	52	55	
8	T18	-	Spring		<5	1054	54	54	
8	T19	Both	Spring		5	1058	52	54	

Stream Flow

Peak flows in East Fork Jemez River are governed by snowmelt, typically spiking in the spring, usually late May to early June. The river is spring fed at its headwaters. Low flow often persists from late summer until the snowmelt in the spring. However, East Fork Jemez Watershed typically receives monsoon events in July through September.

During monsoon events small spikes in stream flow are observed. A flow measurement was taken at the beginning of the survey on July 30, 2001, near the confluence with San Antonio Creek, measuring 7.8 CFS. A study conducted in 1999 suggests that a flow of 11-17 CFS, at the mouth of the East Fork Jemez River, is necessary to sustain the riparian vegetation along the river (Marron Taschek Knight, INC., 1991). During this study the flow at Battleship Rock, near where our measurement was taken, was 10.8 CFS on July 7, 1991 (Gerbrandt, 1991). Low stream flow measurements may be attributed to the 20-year drought conditions.

There are no lakes or reservoirs on the East Fork Jemez River. There may be a few scattered ponds. There are two ponds on the VCNP above the headwater terminus that were created to capture snowmelt and rain water for cattle. These stock ponds have eliminated channel forming events above Jaramillo Creek in Reach 8. Some water is withdrawn from La Jara Creek on the VCNP for tap water for all of the buildings. Approximately 2.69 ac/ft of water is withdrawn from La Jara Creek for VCNP personnel.

Water Temperature

Two the99 543.36095 Tm12 395.55907 626.1605186670074 BT/TT0 1 Tft0r753 626.1605186670graph tidb

meet the standards for salmonid development, a stream must not have a 7-day maximum greater than 64ºF. The East Fork Jemez River did not meet these criteria at both sites. The site below the VCNP boundary exceeded the State standards 70 days out of the 111 total days recorded. The VCNP boundary site exceeded the standards for salmonid development 91 days out of the 111 days recorded, the temperatures spent 22 days between 64° and 70°, and 69 days >70°F. The water temperatures reached levels where mortality in salmonids occurs 62% of the days recorded. The mouth of the East Fork Jemez River exceeded the State Standards 54 days out of 110 days recorded. The site at the mouth exceeded the standards for salmonid development 83 days out of 110 days recorded, the temperatures spent 43 days between 64° and 70°, and 11 days >70°F. The water temperatures reached levels where mortality in salmonids occurs 10% of the days recorded.

Table 12. Monthly temperatures for the East Fork Jemez River thermograph sites.

	East Fork Jemez @VCNP Boundary			East Fork Jemez @ Mouth		
Month	**Max Temp**	**Min Temp**	**Avg Temp**	**Max Temp**	**Min Temp**	**Avg Temp**
June	74.88	47.61	62.87	83.7	49.98	62.56
July	76.11	56.53	66.37	75.11	58.94	66.17
August	76.11	54.03	63.25	70.55	56.41	62.71
September	67.70	45.38	56.10	65.55	48.02	56.87

Figure 2. Monthly water temperatures for East Fork Jemez River at the VCNP Boundary.

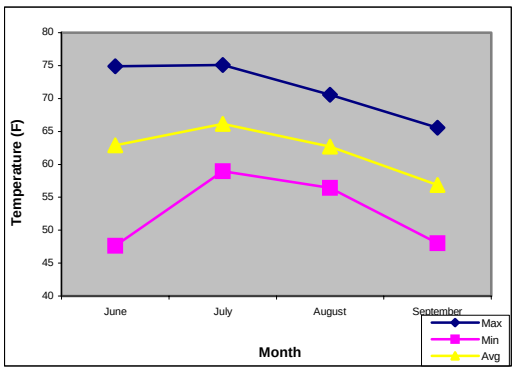
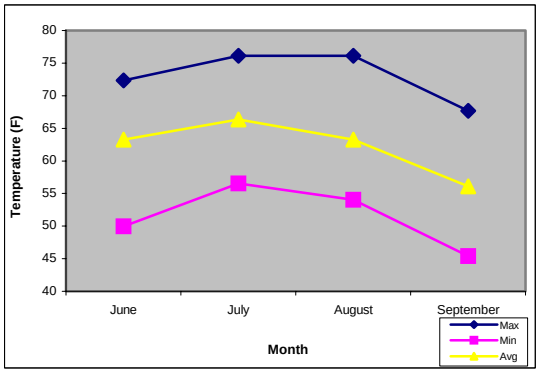


Figure 3. Monthly water temperature for East Fork Jemez River at the mouth.



Riparian Vegetation

Throughout the East Fork Jemez River, alder and willow species dominate the riparian vegetation. Two unique species of botanical interest are located in the watershed: Bunchberry dogwood (*Cornus canadensis*) and giant helleborne (*Epipactus gigantean*). However, once the stream enters Reach 7, above "The Box", the woody species in the riparian areas begin to thin out and are replaced by grass species. Once the stream enters Valle Grande, no woody species are present. In the upper section of the river, Reaches 6-8, cinquefoil was observed. Cinquefoil is a native species that is associated with dry sites. Finding cinquefoil in the riparian area is a red flag. The riparian area is being converted from a wet to a dry site, usually associated with major disturbances such as overgrazing and soil compaction. The majority of the cinquefoil was associated with the

reaches within the VCNP, where grazing from cattle and sheep has occurred for 140 years.

The riparian area throughout the East Fork Jemez River has received numerous disturbances. In Reaches 1, 3, 4, and 6 the main disturbances have been from recreational activities. In all of these reaches, there are trails near the river. This has led to the trampling of riparian species near the trail and the widening of the stream at trail crossings. There are many dispersed campsites along these trails that have increased the soil compaction and removal of vegetative species altogether. The report "An Analysis of the Riparian Zone Along the East Fork of the Jemez River" (Marron Taschek Knight, INC., 1991), states that these same disturbances were occurring in 1991. The report also stated that on the East Fork Jemez River (from the Baca Ranch boundary to the mouth at Battleship Rock) human recreation was the most degrading disturbance and that cattle grazing had very little impact on the riparian vegetation.

Photo 2. Reach 4, NSO 241, P112. Campsite along the East Fork

willows that were regenerating from beaver-chewed stumps. There was an abundance of grasses growing in the nutrient rich sediment left behind the dams.

Beavers are natural stream habitat managers. Beaver dams help create areas where suspended sediment can settle out, reducing stream turbidity. The dams also provide areas for fish to thrive. Ponds create a place for rearing, overwintering, and foraging habitat for fish, as well as providing a controlled flow to downstream areas preventing bank erosion. Though beavers remove riparian vegetation, the net gain of riparian habitat is far greater with beaver populations than without them. The ponds help create an increase in riparian areas, as well as providing a year round water source for the vegetation. Beavers also help stimulate herbaceous understory growth, by thinning out overstory species.

Beavers need to be restored to the East Fork Jemez River. However, before beavers are placed back in the watershed, focus should be placed on riparian restoration. First, riparian vegetation must be allowed to establish in the floodplain. There is a definite lack of woody species, such as willow, aspen, and alder. Currently, woody riparian species are absent in the upper reaches of the East Fork Jemez River. It has been recorded, by the National Riparian Team, that willow species were found on the VCNP, in the Jaramillo Creek Watershed From some of the names in Valle Grande, such as Cerro la Jara and La Jara Creek (Spanish for "willow"), it is evident that willows were found in Valle Grande as well. Just a few miles down river near Las Conchas Fishing Area, there is an abundance of willows, and this is where the historic beaver meadow was found. Once the riparian species return, then beavers can naturally recolonize the East Fork Jemez River. The dams that they build create essential habitat that Rio Grande cutthroat trout and other native fish depend on for rearing and over-wintering habitat.

Fisheries

Fish species found in the East Fork Jemez River include the native species of Rio Grande sucker *(Catastomus plebius)*, Rio Grande chub *(Gila pandora),* fathead minnow *(Pimephales promelas rafinesque)*, and the longnose dace *(Rhinichthys cataractae)*. These four fish comprise the native fish assemblage in the East Fork Jemez River. Non-native species include German brown trout (*Salmo trutta)* and rainbow trout (*Oncorhynchus mykiss).* A hybrid cross between cutthroat trout and rainbow trout was observed in Valle Grande, a possible indication that native trout once occurred in this system. Currently, no Rio Grande Cutthroat trout (RGCT) reside in East Fork Jemez River. RGCT are part of the native fish assemblage as well.

The introduction of brown and rainbow trout assisted in extirpating the native population of RGCT from the East Fork Jemez River. The RGCT is a species that needs high water quality to survive. Rio Grande cutthroat trout is the State Fish of New Mexico and has been placed on the regional forester's list of sensitive species. Range-wide, the numbers of RGCT have dropped dramatically over the last century. At one time, RGCT inhabited nearly all the cool, clear mountain lakes and streams of the Rio Grande basin in Colorado and New Mexico. Now, there are small fragmented populations remaining in the

headwaters of streams, less than 7% of their historic range. Some other causes of the decline of the RGCT are habitat degradation and dewatering of the streams for irrigation. The Jemez Mountains provides a stronghold for RGCT, as seen in San Pedro Parks Wilderness and the Cãnones Watershed. The East Fork Jemez River likely sustained a healthy population of RGCT.

A cultural report from 1892 states that the mountain streams fed"Los Valles" (VCNP) and that the streams "teem with mountain trout" (FS Files). This report pre-dates fish stocking in the Jemez Mountains. The first recorded stocking in New Mexico occurred in 1896 (Sublette et al., 1990). The mountain trout that this report talks about can only be Rio Grande cutthroat trout.

During 1936, a creel census was conducted throughout the state in US Forest Service waters. Included in this report is a stocking history for the East Branch (Fork) Jemez River. During the years 1932-36, 88,300 rainbow trout and 13,500 Yellowstone cutthroat were stocked. During 1936 the creel census recorded that 30% of the fish caught were rainbow, 50% were Yellowstone cutthroat, and 20% were brown trout. No RGCT were caught in the East Fork Jemez River. Unfortunately this report does not say where the creel census was conducted or where the fish were caught or stocked. One can conlude that brown trout were stocked prior to 1932.

During 2001, 1,150 rainbow trout were stocked in the East Fork Jemez River. This year, the stocking regime was at 50% its usual levels due to the closure of Seven Springs and Pecos Fish Hatcheries. There are three areas where these fish are primarily stocked in the East Fork Jemez River. These three sites are at the first roadcrossing going north on NM Highway 4, the Las Conchas Trailhead road crossing, and the Las Conchas Fishing Area. There are no barriers here to prevent upstream or downstream migration.

Reintroduction of RGCT to the East Fork Jemez River Watershed should be considered. This area is a valuable component to establishing a metapopulation, which is described by New Mexico Department of Game and Fish (NMG&F) and the US Forest Service (USFS) as a primary goal in a statewide conservation agreement and the NMG&F management plan for RGCT.

Table 13. Fish Distribution for the East Fork Jemez River.

Fish Species	Native/Non-Native	Distribution	Reaches
Rio Grande Cutthroat	Native	None Found	None
Brown Trout	Non-Native	Mile 0- 21.43	All
Rainbow Trout	Non-Native	Mile 0-21.43	All
Rio Grande Sucker	Native	Mile 0-21.43	All
Rio Grande Chub	Native	Mile 0-21.43	All
Longnose Dace	Native	Mile 0-21.43	All
Fathead Minnow	Native	Mile 12.74-21.43	6-8

However, before the fish can re-establish a population in this drainage, focus must be placed on exotic species removal, improved water quality, and habitat improvement.

First, non-native salmonids must be removed from the stream. Without the removal of the rainbow and brown trout, the RGCT cannot survive in East Fork Jemez River. Part of the stream survey was to locate possible barriers to upstream migration. The survey located several possible upstream migration barriers in Reach 5, from river miles 6.01-7.99 (13.4 miles downstream from the upper limits of fish).

While reintroducing native fish, water quality needs to be improved. Reestablishing riparian vegetation, which was recommended in earlier sections, would help reduce water temperatures by shading the stream and decrease sediment delivery by stabilizing banks and floodplain terraces. Protecting riparian vegetation is necessary in bringing the stream back to a healthy condition. The rehabilitation of East Fork Jemez must allow stream function to return and allow meandering and undercut bank development. Third, education must play a key role in this rehabilitation. People must know what we are doing, and why we are doing this. Once people understand the need to restore this system, they will be able to assist in the successful completion of this rehabilitation project.

Amphibian and Reptile Species:

No amphibians were observed during the survey, but several species were assumed to be found in the watershed, including tiger salamander, Jemez Mountain salamander, western toad, leopard frog, and chorus frog. During the survey two different reptiles were observed. Garter snakes were very common. One short-horned lizard was observed during the survey.

Photo 3. Short-horned lizard seen during the survey along the East Fork Trail #137.

Stream Improvements

There have not been many stream improvement projects on the East Fork of the Jemez River. There was one project that installed approximately 10-12 gabions in the river below Las Conchas trailhead in Reach 6. These gabions were created to restore fish habitat and to prevent further bank erosion from occurring. As is common with gabion structures, the chain link fencing is deteriorating and falling apart. These gabions have in fact only added to the erosion problems in some areas, and have displaced the erosion problems to upstream or downstream sections. Further up river in Reach 6, another stream improvement project was implemented. This project used the placement of LWD to prevent bank erosion and create fish habitat. Much of this project has failed as well. The wood was placed in the streams, and fastened to the substrate using rebar. The log structures were designed to increase fish habitat in the stream as well as prevent further bank erosion. However the structures are not working properly (See Photo 4). The "V" shaped structure has created little habitat, only because the water current is scouring out a pool beneath the structure (See Photo 5). Logs were placed in a bank to prevent erosion and have only increased the rate of erosion by creating scour behind and underneath the logs (See Photo 6). The structures were not able to move with the stream bottom, and are now either floating out in mid stream creating an underscour or causing more bank erosion. These stream improvement projects were using the best technology at the time; however, in order to truly mimic real LWD structures, attaching the structures with rebar or cable is not the best practice. Recent studies show that restoration project should work with natural stream dynamics.

Photo 4. Reach 6, NSO 430, R174. Gabion that is increasing bank erosion. LWD has been placed in front of the gabion to prevent further bank erosion.

East Fork Jemez River is definitely a candidate for LWD placements. However, in order for these projects to work, they must be done correctly. First, the area that is most devoid of LWD is Reaches 6-8. However, Reaches 7 and 8 are on the Valle Grande. Valle Grande is a low gradient meadow system defined by grass banks. There was no source for woody recruitment on Valle Grande. However, once you proceed downstream of Valle Grande into the "Hidden Valley" section of the VCNP, the stream passes through small conifer stands. These areas were possibly full of aspen at one time, but with historic land management practices, these stands have disappeared. It was areas like these that would make ideal beaver habitat, and eventually excellent RGCT habitat.

Photo 5. Reach 6, NSO, 492 R199. Old stream improvement project. These 6 pieces of wood were placed into the stream in an upstream direction forming a "V". The structure has increased scour underneath the structure and widened the stream upstream of the structure.

In areas like Hidden Valley, it is possible to place LWD structures in the stream channel and floodplain to help mimic a natural logjam. Reaches 4 and 6 are the best candidates. However, the rest of the East Fork Jemez River would benefit more from focusing on water quality improvement.

Photo 6. Reach 6, NSO 487, R197. LWD placements along bank. Note bank instability.

Land Use

A variety of land use practices occur in the East Fork Jemez River watershed.

Roads:

The East Fork Jemez River Watershed has an extensive road system. There are approximately 8.8 miles of road per square mile throughout the entire watershed. This is well above the US Fish and Wildlife Service recommended amount of less than 2.5 miles per square mile. The majority of the roads throughout the watershed fall in the VCNP, where there are approximately 10 miles of road per square mile. Many of the roads located in the watershed are old roads that are not currently in use or maintained. These unmaintained roads are sources of extensive sediment delivery in the East Fork Jemez watershed. During rain events, roads gully or wash out, inputting sediment into the stream. The road system on the VCNP is a major concern. Many of the current roads are poorly designed, as most roads are constructed below grade causing rain water to collect on the roads, increasing erosion (USFS Report on Watershed Concerns Summer of 2001). The roads in the VCNP are increasing the amount of fine sediments in the stream. The road system outside of the VCNP is much less extensive. There was no evidence of increased sediment loads from the road system outside of the VCNP.

Photo 7. Valles Caldera National Preserve. Gully formed between two logging roads. Notice heavy erosion and exposed tree roots.

Timber Harvest:

Forests in the East Fork Jemez River consist primarily of ponderosa pine (*Pinus ponderosa)*. However, higher elevations produce Douglas-fir (*Pseudotsuga menziesii*) and a mix of spruce and fir. Timber harvesting has gone on for as long as people have inhabited the area. There is no record to show when the first timber harvest occurred in the East Fork Jemez River Watershed, but there is a noted history of private harvest on the 100,000 acre San Diego Land Grant that was turned over to the USDA Forest Service in 1965.

There have only been two major timber sales in the East Fork Jemez River Watershed within the last decade. The largest sale was Bonito Timber Sale and was completed in 1993. The sale units covered a total of 383 acres within the watershed and removed approximately 4.66 MMBF total. All sale units were up slope from the floodplain; none of which reached the stream.

The second timber sale was the Banco Timber Sale, located in the East Fork Jemez and San Antonio Creek Watersheds. This project was completed in 1991. The sale units covered a total of 193 acres within both watersheds. Approximately one third of the sale fell in the East Fork Jemez Watershed. The sale removed approximately 1.24 MMBF total.

Future recommendations for timber harvest in the East Fork Jemez River Watershed should include no harvesting of timber for sale or for firewood within 100' of live water. Public educational signs should be posted to let the public and firewood collectors know the importance of LWD to streams and their inhabitants.

These two timber sales were the only ones on the National Forest; however, high quantities of timber harvesting occurred on the VCNP. The Report on the Study of the Baca Location #1 states that timber harvesting is still an attractive activity; though high levels of timber harvesting occurred in the past. The forests that were logged in the past were replanted with young trees and will need thinning in the future.

Table 14. Logging occurrences and area on the Baca Ranch.

Years	Acreage Logged
1935-1963	25,640
1963-1972	10,598
1972-1980	None
1980-1993	2,739
Total Number of Years:	Total Acreage:
58	38,977

In 1963, in reaction to an outbreak of spruce budworm, the Santa Fe National Forest sprayed the Jemez District with DDT. Stations were set up to monitor the effects on the fauna of the area. One station was near the Jemez Falls and Las Conchas Campgrounds. No detrimental effects were found in the study areas. The helicopters flew low in the areas of concern to avoid any drift of spray (USFS Fisheries Files).

Fires:

Fire has played an important role in the forests of northern New Mexico. All of these forests have adapted to a natural fire regime. However, with human intervention this natural fire regime has been severely altered. The fire suppression that has occurred for nearly a century has allowed fuels to build up in the forests. When a fire does occur it now has the potential to become a catastrophic fire, as was seen in the 2000 Cerro Grande Fire. There have only been two major fires within the East Fork Jemez Watershed over the last 35 years. The earliest fire was the Las Conchas Fire, which burned approximately 300 acres in 1968 (Reach 5). The Falls Fire of 1978 burned approximately 200 acres in Reaches 1 and 2 (See East Fork Jemez River Map in File). These two fires were the only ones in the watershed that would have had any significant effect on the soils and the river according to Phil Neff, Fire Management Officer for the Jemez Ranger District (Personal Communication, 2001). Within the next 2-3 years, the area around Sierra los Pinos was thinned, and the piles will be burnt and broadcast around the 545-acre area (Reach 3).

Grazing:

Grazing has been a tradition in Northern New Mexico since the settlement of this area. Public land grazing has occurred for nearly a century. Prior to the establishment of the Santa Fe National Forest, the watershed had likely been grazed for 50-100 years.

Table 15. Las Conchas Allotment Grazing Rotation.

Numbers of Cattle	Pasture	Reach Effected	Grazing Period
27 Pair	Pumice	6	6/1-6/12, 7/28-8/21
27 Pair	Las Conchas	6	6/13-6/20, 9/23-9/30
27 Pair	North	5,6	6/21-7/7, 7/20-7/27, 8/22-9/8
27 Pair	East	6	7/8-7/19, 9/9-9/22

In the East Fork Jemez River there are two major grazing allotments: Las Conchas Allotment and V-Double Slash Allotment. These allotments are made up of different pastures, where the cattle are rotated from May 1 to November 7. The Las Conchas Allotment holds 27 Cow Calf pairs and the V-Double Slash Allotment holds 148 cow calf pairs. The entire Las Conchas Allotment falls within the East Fork Jemez River Watershed. There is an agreement between the USFS and the permitee of the Las Conchas Allotment, cattle will not graze in the riparian areas, from the East Fork Trail Head to the western allotment boundary, except during drought conditions. All the pastures affect either Reach 5 or 6. The grazing pressure was heaviest in the North and East pastures. In the North Pasture, the stubble height along the stream has 2-3" in height. The amount of bank erosion was relatively low for this pasture. However, there was evidence of the riparian areas being converted from a wet site to a dry site. Cinquefoil was very common in this pasture, which went right down to the edge of the stream. No cows were seen during the survey, but there was sign of cattle all around the area.

Table 16. V-Double Slash Allotment Grazing Rotation.

Numbers of Cattle	Pasture	Reach Effected	Grazing Period
Rivera/Paliza			
27 Pair	East Paliza	None	6/1-6/30 and 9/16-9/30
27 Pair	Middle Paliza	None	7/1-8/15
27 Pair	Watershed	None	8/16-9/15
Trujillo/V Double Slash		None	
148 Pair	West Paliza, Rivera, Middle Paliza	None	5/1-6/1
148 Pair	Watershed	None	6/2-6/15
148 Pair	Los Griegos	5,6	6/16-7/16
148 Pair	Banco Bonito, Jemez Falls, North	1,2,5	7/17-8/7
148 Pair	Los Griegos	5,6	8/8-8/15
148 Pair	Middle Paliza, Rivera	None	8/15-9/30
148 Pair	West Paliza	None	10/1-11/7
100 > 6 mo. Old	Borrego	None	11/8-4/30
48 > 6 mo. Old	San Jose	None	11/8-4/30

The East Las Conchas pasture showed the most signs of heavy grazing use. The main pasture was up on top of the ridge, away from the stream. The cattle had several trails down to the river to get water. These cattle trails were sites of major erosion problems. During the rainstorms, these trails acted like small streams. The heavy use by the cattle

had removed all vegetation from the trail, and bare soil was exposed to the streams of water running down the trails. At the bottom of one of these trails, a small alluvial fan was beginning to form. Bank erosion in this section of the stream was greatly increased from the amount in the North Las Conchas Pasture. A short time after the survey had passed through this stretch of stream on October 3, 2001, one of the Fisheries Crew members returned to check a thermograph that was situated in the area. The crewmember reported fresh cattle dung all over this area, with some dung found in the stream.

The V-Double Slash allotment has more cattle grazing it than the Las Conchas Allotment, but the majority of this allotment doesn't affect the East Fork Jemez Watershed. Except for 4 pastures, the rest fall into a different watershed. The effects of these pastures were not evident on the stream, as the majority were too far away from the stream itself.

Grazing on the Baca Ranch has been occurring since late in the 19th century. Sheep were grazed until about 1940, when cattle were introduced. There are about 30,000 acres of grassland on the VCNP. From the 1950-1960's approximately 12,000 head of cattle grazed on the Baca Ranch annually. From the late 1960's through 1999 approximately 5,000-6,000 head had been grazing the grasslands annually. These numbers account for approximately 50% of the cattle that graze in the Jemez Mountains. It is estimated that the VCNP could support the current level of cattle grazing indefinitely. (Report on the Study of the Baca Location #1, 1993).

Photo 8. Reach 7, NSO 504, P193. One example of bank erosion occurring in the Valle Grande. Undercut banks have been sloughing off into the water creating a large sediment input to the East Fork Jemez River. Note the raw muddy banks.

If the VCNP wants to continue to graze cattle on these fertile grasslands, then changes to riparian management need to occur. It is evident that grazing has caused serious bank erosion problems. Thirteen thousand three hundred thirty three feet of unstable banks were recorded in the upper section of Reach 6, and Reaches 7 and 8 in their entirety. Many of the undercut banks, which are essential fish habitat in meadow systems, have sloughed into the river. The lack of riparian vegetation, stream bank trampling, and stream widening from historic grazing has exacerbated the bank erosion problem. Eroded banks were seen on nearly every stream bend in Valle Grande. Since a meadow system is typically very sinuous, the unstable banks were significantly increased from the other reaches due to the increased numbers of stream bends in these reaches. The majority of East Fork Jemez River had extremely stable banks, until it entered the VCNP. During the survey, heavy bank erosion was noted throughout reaches 6-8. The Santa Fe National Forest Fisheries program recommends resting the riparian area for at least 5 years until a healthy riparian community can establish itself along the East Fork Jemez River. Once a healthy riparian ecosystem is established, a range rider could be used to minimize grazing utilization of the riparian areas. Elk fences could be placed in areas to monitor the impacts of elk utilization. Resting will also settle the argument as to whether or not there should be woody riparian species in Valle Grande.

Another consideration is planting the riparian vegetation in protective tubes to prevent elk from browsing the new plants until they are large enough to handle browsing.

Recreation

The East Fork Jemez River is located within the Jemez National Recreation Area (NRA) and has 6 developed recreational sites within the watershed: one campground, (Jemez Falls Campground), one picnic area, (Battleship Rock Picnic Area), two trailheads, (East Fork Trailhead and Las Conchas Trailhead), one fishing area, (Las Conchas Fishing Area), and one trail #137 (The East Fork Trail). The Jemez NRA reportedly has 2 million annual visitors. This will obviously increase with the opening of the VCNP.

In addition to these developed recreation sites there are many dispersed trails and campsites. One popular dispersed trail leads along the East Fork Jemez River from Battleship Rock to Jemez Falls (Reaches 1 and 2), even though there is one developed trail in this area. There are numerous dispersed trails that run off along the river and to McCauley Warm Springs (Reach 1). Another popular dispersed site is at NM Highway 4 (Reach 4) near the East Fork Trailhead (T18N R4E S2). This is a pull out that NMDOT built when they replaced a bridge with the culvert. This area attracts numerous visitors daily throughout the early spring, summer, and early fall. Most of these visitors are going to the “Jumping Off Point”, a highly used swimming hole where people jump off of 50’ high cliffs into several deep pools, often crossing VCNP property. From this site upriver to the Las Conchas Trailhead seems to get the most recreational use excluding approximately two miles of the river through “The Box”.

Photo 9. Reach 1 NSO 1. Streambank in a heavy recreational use area. Soil compaction caused by dispersed trail use along the East Fork Jemez River near Battleship Rock.

The heavy use of these areas has degraded riparian areas, as well as the stream itself. The numerous dispersed trails, especially near the river, have created sediment inputs to the stream. The trails have also caused soil compaction, which prevents riparian vegetation from re-establishing in these areas as well as stream widening. Many of the dispersed campsites can be found in the floodplain, and have created similar problems to the riparian vegetation. These areas have been totally "browned out" (no vegetation in the campsites due to soil compaction).

Dispersed trails along the East Fork Jemez River should be closed off and rehabilitated to promote riparian vegetation growth. The hikers should be using one trail along the entire East Fork Jemez River with an established alternative riverside trail in high use areas. Educational signs should be placed to inform people about the importance of riparian vegetation and healthy streams.

Dispersed campsites should also be closed off, and rehabilitated. These areas should be designated as "Day Use Only" areas to prevent people from camping in the floodplain. If these campsites were closed down, the riparian vegetation would reestablish in these areas. Riparian vegetation should be restored to restore proper functions to the riparian ecosystem. An educational sign should be placed at trailheads, as well as the closed campsites. A person should patrol these areas informing the public about the proper practices necessary for low-impact recreation and keeping visitors informed as to the local regulations.

Recommendation Summary

The first and most important recommendation is that the Santa Fe National Forest, in conjunction with the VCNP, should develop and implement an education campaign regarding, but not limited to, all of the recommendations that are made. Public education is clearly the most important change that must be made for any of the other recommendations to be successful. Programs can spend millions of dollars repairing damage that was done in the past, but if the public isn't properly informed about what you are doing and why you are doing it, then the money will have been spent needlessly. Without education the same activities will occur, and the damage will continue.

The riparian community must be restored to a healthy condition. A healthy riparian community in the VCNP and the Santa Fe National Forest is critical to help improve the water quality of the East Fork Jemez River. In order to restore the riparian community within the VCNP, the riparian areas must be rested from grazing for a prescribed period of time until the riparian community is re-established. Grazing practices should be managed to protect the riparian area once it is re-established, either by using a range rider, riparian exclosures, or rotational grazing that would not allow grazing until the dormant season. Another step that must be taken to restore riparian areas is to limit the use of the dispersed trails and campsites. The areas that have been damaged should be restored back to a healthy riparian condition.

One of the most exciting opportunities, due to the recent establishment of the VCNP is the potential reintroduction of RGCT. The first step in restoring this native fish would once again be public education. The benefits of restoring the habitat and water quality would not only benefit RGCT, but would also help the rest of the native fish assemblage found in the East Fork Jemez River. Once the process has begun, one possible measure that might be taken would be to allow the waters to be opened to fishing without any bag limits on the non-native fish (rainbow and brown trout). This would succeed in reducing the population of these fish, as well as increasing the public's interest in the project. Once the population has been knocked down, a treatment could be implemented in stages, gradually expanding the range of RGCT. In conjunction with reintroducing RGCT, beaver recolonization should be promoted. Bringing beaver back to the East Fork Jemez would be a way of restoring habitat that would be much more financially and ecologically acceptable. Beavers are much better at engineering stream habitat.

Reach Summaries

Photo 10. Reach 3. The lower canyon area above Jemez Falls.

Reach 1: Battleship Rock to McCauley Warm Springs

Reach 1 begins at the mouth, which is the confluence with San Antonio Creek, near Battleship Rock (T 19N, R3E, S32). The survey of this reach started on July 4th, and ended on July 22nd, 2001. This reach starts at 6750' above sea level and continues upstream for 1.95 miles just upstream from the confluence with McCauley Warm Springs where there is another steep gradient change at elevation 7280'(T18N R3E S3). This reach is steep with an average gradient of 5.14%. A cobble substrate type dominates this reach. The Rosgen channel type for this reach is an A3 type channel.

Reach 1 runs through a heavy recreational use area. Battleship Rock Picnic Area and the lowest trailhead for the East Fork Trail are in this reach, as well as the Camp Shaver YMCA camp. This reach also receives heavy fishing pressure from the picnic area and dispersed fishing trails associated with the parking area.

The riparian community consists mostly of woody species such as willow with some alder. Most of the ground was covered with grasses. This vegetation helped stabilize the banks. The majority of the overstory throughout this reach consisted of ponderosa pine, with some Douglas-fir and juniper.

Brown trout were observed during the survey. It is likely that the native fish assemblage is found in this reach, except for Rio Grande cutthroat trout, as well as rainbow trout and cutbows.

Table 17. Water temperatures calculated from grab samples in Reach 1.

Reach	Max. Temp	Avg. Temp	Min. Temp
1	67	62.9	60

The thermograph data collected determined that the mouth of the East Fork Jemez River was **not properly functioning** exceeding the state standards 57 days out of 114 days recorded. The site at the mouth exceeded the standards for salmonid development 91 days out of 118 days recorded.

Table 18. Monthly temperatures for East Fork Jemez River thermograph site.

East Fork Jemez @ Mouth			
Month	**Max Temp**	**Min Temp**	**Avg Temp**
June	83.7	49.98	62.56
July	75.11	58.94	66.17
August	70.55	56.41	62.71
September	65.55	48.02	56.87

Water temperatures were also recorded with grab samples throughout the survey. The maximum temperature calculated from the grab data was 67º F, the average temperature for Reach 1 was 62.9º F, and the minimum temperature recorded during the survey was 60º F. The temperatures fall within the range of RGCT habitat characteristics, where the ideal temperature range is 64-70º F.

Habitat Characteristics

During the habitat survey conducted on Reach 1, the river was broken up into a total of 116 NSOs, measuring 10,304 feet in length. Of the 116 NSOs, almost 50% were pools. However, these 55 pools comprised only 18.2% of the stream habitat for Reach 1, 48 riffles accounted for 73.1% of the stream habitat. There is 4 times more riffle habitat than pool habitat. The amount of side channel habitat is the highest of any reach in the entire river. While pool volume is moderately low, there is opportunity to increase pool formation with the introduction of LWD . The amount of side channel habitat is due to the high gradient stream and the large quantities of boulder present in this reach.

Table 19. Overall Stream Summary for Reach 1.

Reach 1					
Stream Length Surveyed:	10304 feet			1.95 miles	
Gradient:	5.14%		**Rosgen Channel Type:**	A3	
Habitat Type	**Total Number**	**Total Feet Of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	55	2048	19.9	18.2	>30%
Riffle	48	8256	80.1	73.1	-
Culvert	0	0	0	0	-
Tributary	2	-	-	-	-
Falls	0	0	0	0	-
Side Channel	11	977	NA	8.7	-
Total	116	11281	100.0	100.0	-

When compared to the matrix of factors and indicators of stream health condition for historic and occupied Rio Grande cutthroat trout streams, Reach 1 is **not properly functioning** for all criteria in the category of habitat characteristics and channel condition, except sediment levels and pool quality.

Table 20. Summary of Habitat and Substrate Percentages for Riffles in Reach 1.

Riffle Habitat Summary						
Reach	# Riffles	Avg. Length	Avg. Width	Avg. Depth	Avg. Max. Depth	
1	48	172.0	22.0	1.0	2.2	
Substrate Summary						
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
1	17.5	20.8	29.8	27.9	4.0	100.0
Properly Functioning Indicators	<20.0	-	-	-	-	-

The average riffle in Reach 1 is quite normal. These riffles are healthy. Riffles in Reach 1 are **properly functioning** for average sediment amounts, with 17.5% sand (sand, silt, clay, and fines), which is below the <20% criterion. Reach 1 is a high gradient reach, and because of this the velocity of stream flow through this reach is not conducive for the settlement of fine substrates. Sand is typically passed through reaches with a gradient this high.

Reach 1 was **properly functioning** for pool quality. The average residual pool depth was 1.4, exceeding the properly functioning indicator of 1' (See Table 16). Overall the average pool was of adequate quality, but the amount of pool habitat in Reach 1 was below acceptable levels. Reach 1 was **not properly functioning** for pool quantity, with the amount of pool habitat as 18.2%. The indicator for a properly functioning stream is ≥30% pool habitat. A stream with an "A" type channel should have more pools than is currently found in Reach 1. A typical A channel is a step-pool system, meaning that it has short riffles, or steps, in between pools. However, this reach is lacking in pool formation. One reason for the lack of pool habitat may be due to observer error. Many boulder cascades were observed in this reach. A cascade is a system of steep riffles intermixed with pocket pools. In lumping these habitats together into a riffle, some pool habitat was not measured.

Table 21. Summary of Pool Habitat and Substrate Percentages in Reach 1.

Pool Habitat Summary												
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile	
1	55	37.2	20.1	3.1	1.7	1.4	28.2	47	24.1	25	12.8	
Properly Functioning Indicators	-	-	-	-	-	<1'	-	-	-	-	-	
Substrate Summary												
	Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total					
	1	22.4	24.0	24.9	24.4	4.3	100.0					

One reason for the lack of pool habitat in Reach 1 is due to the lack of LWD. Reach 1 did not meet the criterion of >30 pieces of LWD per mile needed for a properly functioning stream.

Table 22. Habitat Characteristics for the Reach 1.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
1	1.15:1	23:1	8.7	4360	21.21[1]
Properly Functioning Indicators	-	-	>30	-	-

[1] Unstable banks were left out of this analysis due to high gradient of Reach 1

Reach 1 was **not properly functioning** with 8.7 pieces of LWD per mile. This lack of LWD can be attributed to removal of LWD from fish bearing streams. It was a common practice, in the middle part of this century, to remove LWD from streams. Logjams were seen as barriers to fish passage. However, LWD does not hinder fish movements. In fact LWD is an essential part of pool formation, and is critical 222.Nidif

Some of the causes for this reach not meeting the guidelines can be attributed to the heavy recreational use that occurs in this reach. Battleship Rock Picnic area is situated on the northern bank of the river, and YMCA Camp Shaver is situated on the southern bank. Both sides of the river are riddled with dispersed trails. These dispersed trails are the main causes of the bank instability in this reach, further causing stream widening. With some rehabilitation, such as planting willows and other native grasses, the bank stability could be increased dramatically. LWD and pool development were other criteria that were not properly functioning. Both these have relatively easy forms of rehabilitation. Adding LWD to Reach 1 would benefit the stream, by increasing stream health, and would also benefit the recreational anglers by creating better fish habitat. LWD placement would also aid in creating more pool habitat for Reach 1. Fortunately the forested area is old enough to provide natural recruitment of LWD in the future. This would return the stream channel to its natural functioning condition, dramatically decreasing the bankfull width to depth ratio to natural levels.

If this reach were to be rehabilitated, then educational signs would be necessary in this area to ensure that the restoration would be truly effective. This area receives heavy recreational use from early spring to late fall.

Photo 12. Reach 1. Typical high gradient riffle from Reach 1. Notice the natural bank erosion on the right bank.

Reach 1 had two tributaries in the entire reach. Both of these tributaries were warm springs. One was McCauley Warm Springs. The water temperatures were measured of the tributaries. Tributary #1 measured 75º F and Tributary #2, McCauley Warm Springs, measured 79º F, while the main river measured 63ºF. These two tributaries are

contributing to elevated water temperature of the East Fork Jemez River. One reason why the water temperature is so warm in the East Fork Jemez River is due to geothermal springs created by the volcanic history of the Jemez Mountains.

Reach 2: From McCauley Warm Springs to Jemez Falls

Reach 2 begins at a sharp gradient increase just after McCauley Warm Springs enters the East Fork Jemez River on the left bank. The survey of this reach started on July 23rd and continued through the July 24, 2001. This reach begins at 7280' above sea level (T18N R3E S3)and continues up into the Jemez Mountains for 1.2 miles where it stops at the top of Jemez Falls, which are approximately 100' tall, at 7770' elevation (T18N R3E S10). This reach is very steep, with an average gradient of 7.53%. The Rosgen channel type for this reach is an A2 type channel. Reach 2 is dominated by a boulder substrate, which is typical of high gradient streams.

The East Fork Jemez River runs through a narrow canyon constricting channel movement. The East Fork Trail is several hundred feet above the riverbed, with no remarkable erosion problems. The reach is dominated by large bedrock and boulder formations, with some of the boulders being much larger than a VW beetle.

The riparian community for Reach 2 is similar to Reach 1. There are fewer willows in this reach however, with some alder. The stable banks were covered with grasses as well. The overstory was comprised mostly of ponderosa pine with some Douglas-fir.

Brown trout were observed during the survey. It is likely that the native fish assemblage is found in this reach, except for Rio Grande cutthroat trout, as well as rainbow trout and cutbows.

Table 23. Water temperatures calculated from grab samples in Reach 2.

Reach	Max. Temp	Avg. Temp	Min. Temp
1	66	64	62

There was no thermograph placed in Reach 2, so there is no definitive temperature data associated with Reach 2 to be compared to state and forest water quality guidelines. During the survey, grab temps were taken throughout he day. It was determined from the grab temperatures that the overall maximum temperature for Reach 1 was 66º F, the average temperature was 64º F, and the minimum was 62º F. The water temperatures for Reach 2 fall within the necessary range for RGCT, which is <64-70º F.

Habitat Characteristics

During the habitat survey conducted on Reach 2, the river was broken up into a total of 78 NSOs, measuring 6511 feet in length. Of the 78 NSOs, approximately 48% were pools. However, these 37 pools comprised only 19.9% of the stream habitat for the entire reach, 33 riffles accounted for 72.4% of the stream habitat. There is almost 4 times as much riffle habitat in this reach as there is pool habitat. Side channels make up a very small part, 4.4%, of the stream habitat. The lack of pool and side channel habitat is likely within the range of natural variability.

Table 24. Overall Stream Summary for Reach 2.

Reach 2					
Stream Length Surveyed:	6511 feet		1.20 miles		
Gradient:	7.53%		**Rosgen Channel Type:**	A2	
Habitat Type	**Total Number**	**Total Feet Of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	37	1353	20.8	19.9	>30%
Riffle	33	4933	75.7	72.4	-
Culvert	0	0	0	0	-
Tributary	0	-	-	-	-
Falls	2	225	3.5	3.3	-
Side Channel	4	300	-	4.4	-
Total	78	6811	100.0	100.0	-

When compared to the matrix of factors and indicators of stream health condition for historic and occupied Rio Grande cutthroat trout streams, Reach 2, is **not properly functioning** for all criteria in the category of habitat characteristics and channel condition, except sediment levels and pool quality. Streambank condition was omitted from this analysis, as the gradient in Reach 2 was > 4%, and high amounts of natural bank erosion would occur at high gradients.

Table 25. Summary of Habitat and Substrate Percentages for Riffles in Reach 2.

Riffle Habitat Summary						
Reach	# Riffles	Avg. Length	Avg. Width	Avg. Depth	Avg. Max. Depth	
2	33	149.5	19.6	1.2	2.3	
Substrate Summary						
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
2	18.5	17.5	23.1	36.5	4.4	100.0
Properly Functioning Indicators	<20.0	-	-	-	-	-

The average riffle in Reach 2 is normal. The riffles are healthy in this reach. Riffles in Reach 2 are **properly functioning** for average sediment amounts, with 18.5% fines (sand, silt, and clay,), which meets the <20% criteria. Reach 2 is a high gradient reach, and because of the velocity of the stream flow, this reach is not conducive for the settlement of fine substrates. Sand is typically passed through reaches with high gradients such as Reach 2.

Reach 2 was **properly functioning** for pool quality, with an average residual pool depth of 2.7', which exceeds the minimum of >1'. Overall the average pool was of adequate quality, but the amount of pool habitat in Reach 2 was below acceptable levels. Reach 2 was not properly functioning for pool formation, with the amount of pool habitat of

19.9%, which is well below the necessary level of ≥30% pool habitat for a properly functioning stream. A typical "A" type channel should have more pools than Reach 2 has. Typical "A" channel types are a step-pool system, meaning that it has short riffles, or steps, in between pools. However, this reach is lacking in pool formation. One reason for the lack of pool habitat may be due to observer error. Many boulder cascades were observed in this reach. A cascade is a system of steep riffles intermixed with pocket pools. In lumping these habitats together into a riffle, some pool habitat was not measured, and is likely **properly functioning** or within the range of natural variability.

Table 26. Summary of Pool Habitat and Substrate Percentages in Reach 2.

Pool Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
2	37	36.6	25.0	3.5	0.8	2.7	29.3	37	29.3	23	18.7
Properly Functioning Indicators	-	-	-	-	-	>1'		-	-	-	-

Substrate Summary							
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total	
2	20.6	17.8	20.3	28.9	12.5	100.0	

Table 27. Habitat Characteristics for the Reach 2.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
2	1.13:1	16:1[1]	15.5	459	3.5[2]
Properly Functioning Indicators	-	-	>30	-	-

[1] The average riffle width:average depth ratio was used here, as no bankfull measurement was made during the survey
[2]

area reduces the amount of LWD that is transported downstream, by capturing all the LWD on bottle-necked bedrock features within the canyon.

The bankfull width-to-depth ratio for Reach 2 was calculated using the average riffle width to depth ratio. During the survey, no bankfull measurement was taken for this reach. The width to depth ratio of 16:1 exceeds the <12:1 ratio necessary for a properly functioning "A" type channel. Due to its geologic confinement, this reach is likely within the range of natural variability.

Reach 2 receives the least amount of recreational use below Jemez Falls. The access to this reach is extremely poor. The river runs through a steep canyon and the East Fork Trail #137 is up on top of the canyon, away from the stream. There are no real dispersed trails in this section, until you get within 500' of Jemez Falls. Surveying the last quarter mile of the stream was extremely difficult, due to poor access to the stream channel. Large boulders, making it almost impossible to measure stream habitats, dominated the channel. Unfortunately most of the last 500-750 feet of stream measurement were estimated.

Photo 13. Reach 2. Recently created log jam in the East Fork Jemez River. Notice the gravels beginning to pile up behind the LWD. This was located in a steep section of the river, where it was acting to aggrade the channel.

The majority of the forest in this reach is old enough to begin adding LWD to the stream, but due to the high gradient in this reach, not much of the wood will remain here. It will be flushed downstream, or pileup on the large boulders out of the stream channels. Photo 13 shows one of the few new logjams created in the East Fork Jemez River. There were several nice logjams found in the lower section of this reach, where the gradient wasn't as high as the upper section.

Reach 3: Jemez Falls to NM Highway 4 Crossing

Reach 3 begins at the top of Jemez Falls. The survey of this reach started on July 25th and continued through July 31, 2001. This reach begins at 7770' above sea level (T18N R3E S3) and continues upstream for 1.85 miles where it stops at the NM Highway 4 culvert at 7947' elevation (T18N R3E S2). The average gradient for Reach 4 is 1.81%, a drastic reduction in comparison to Reach 2. The Rosgen channel type for this reach is a C1 type channel. The stream substrate is dominated by bedrock.

From Jemez Falls upriver, the stream becomes more bedrock dominated. There are 2 falls in this reach. The observer may have missed calling some of these bedrock features, lumping them as cascading riffles. Through the middle of Reach 3, the East Fork Jemez River passes through a small canyon. There are very steep bedrock walls on both sides of the river throughout this canyon section. The geologic formations seem to be very different above Jemez Falls than below the falls. The rock above the falls consists primarily of rhyolite, which is a very soft highly erosive rock type. There are many large holes in the bedrock created by scouring from water and loose rocks. There was also an increased amount of aquatic vegetation and algae in this reach compared to the previous two. The riffles in this reach were primarily deep slow moving riffles, also known as glides. The East Fork Trail #137 passes along both sides of the lower section of the reach, before it climbs up out of the valley. There is some heavy recreational use at the very beginning of the reach near Jemez Falls Campground and at the very end of the reach near the NM Highway 4 culvert. The middle section of the reach receives very little recreational use due to poor accessibility.

The riparian community for Reach 3 is very similar to the three previous reaches. However, there is less willow in Reach 3 and more alder. The stable banks are covered with grass as well.

Brown trout were observed during the survey. It is likely that the native fish assemblage is found in this reach, except for Rio Grande cutthroat trout, as well as rainbow trout and cutbows.

Table 28. Water temperatures calculated from grab samples in Reach 3.

Reach	Max. Temp	Avg. Temp	Min. Temp
3	70	66.6	63

There is no thermograph data associated with Reach 3, so there is no definitive water temperature data to compare to state and forest water quality guidelines. During the survey, grab temperatures were taken throughout the day. It was determined from these grab samples that the overall maximum temperature for Reach 3 during the survey was 70º F, the average temperature was 66.6º F, and the minimum temperature was 63º F. The maximum temperature for this reach exceeds the preferred range of <64-70º F for RGCT. However, the average temperature for the reach falls within the range.

[redacted]

this reach is being carried downriver from the VCNP. The VCNP is the only sediment source upstream of this reach. Reach 3 is a low gradient reach, and because of the velocity of the stream flow, this reach is conducive for the settlement of fine substrates. Sand is typically collected in reaches with a gradient as low as the gradient found in Reach 3.

Table 31. Summary of Pool Habitat and Substrate Percentages in Reach 3.

Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
3	19	93.0	40.1	3.7	0.6	3.1	10.3	19	10.3	11	6.0
Properly Functioning Indicators	-	-	-	-	-	>1'		-	-	-	-

Substrate Summary							
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total	
3	22.6	22.1	19.0	1.6	34.7	100.0	

Reach 3 was **properly functioning** for pool quality, with an average residual pool depth of 3.1', which exceeds the minimum of >1'. Overall the average pool was of adequate quality, but the amount of pool habitat in Reach 3 was below acceptable levels. Reach 3 was **not properly functioning** for pool formation, with the amount of pool habitat of 17.9%, which is well below the necessary level of ≥30% pool habitat for a properly functioning stream. A typical "C" type channel should have more pools than Reach 3 has. Bedrock features dominate Reach 3. A larger percentage of pool habitat is associated with bedrock substrate. The subdominant substrate is fines with 22.6% of substrate in pools. It is concluded that a large portion of the pool habitat was lost in this reach due to siltation. .

Table 32. Habitat Characteristics for the Reach 3.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
3	1:1	27:1	23.78	225	1.2
Properly Functioning Indicators	-	-	>30	-	<10

Reach 3 is **at risk** for LWD, with 23.78 pieces per mile, which is well below the necessary >30 pieces per mile necessary for a properly functioning stream. The lack of LWD in this reach can be attributed to two factors. First, fire suppression practices have reduced the amount of LWD recruited into the stream channel. Fire ecology is an important part of the landscape in New Mexico. Large fires would remove the understory, and open up the canopy for ponderosa pine, the dominant species in this reach. Fires assist in LWD recruitment for stream in this region. The dying trees would eventually fall into the stream channel. The stream would then move the LWD during

floods to places where the wood could create habitat. The lack of major fires over the last century has greatly diminished the amount of LWD in New Mexico streams. Another factor in the reduced amount of LWD in this reach is due to the design of the culvert under NM Highway 4. This double culvert does not allow for the passage of sizable LWD. "C" Type channels like Reach 3 were typically where LWD would be found. It is downstream of a forested landscape, and the bottlenecked bedrock features found throughout the reach would have captured most LWD that was being transported downstream.

Photo 14. Reach 3. Typical riffle from this reach. Notice the bedrock substrate, riparian grasses, and deep eroded potholes in the bedrock.

The amount of unstable banks in Reach 3 was 1.2%, well below 10%. Therefore, reach 3 is properly functioning for streambank condition. The majority of the strembanks of this reach consist of bedrock.

The bankfull width-to-depth ratio for Reach 3 is 27:1, well within the necessary range of 12-30 for a "C" Type channel. Therefore, Reach 3 is **properly functioning** for the criterion for width-to-depth ratio.An observation that was made after the survey was conducted was the difference in habitats between Reach 3 and 4. The culvert that breaks the two reaches is having a definite affect on the geomorphology of the East Fork Jemez River. The culvert has acted as a LWD catcher in the stream. The LWD is removed from the river, as NMDOT must remove LWD that collects at the culvert inlets to prevent damage to the culvert and road. The section of river below the culvert is much higher in gradient than the average gradient of the entire reach. This area was dominated by a boulder/cobble substrate, similarly to Reaches 1 and 2. Reach 4, above the culvert was, likely, similar to this stretch of stream. However, once the culvert was created, it changed the stream dynamics of this area. The culvert has acted like a dam, slowing down the flow through this area and allowing the fine sediments to settle out, as will be seen in the Reach 4 summary.

To correct the damage caused by the culvert the culvert must be replaced with a bridge. The bridge should allow for the passage of LWD, as well as the natural function of the stream channel during a 100-year flood event.

Reach 4: NM Highway 4 Culvert to "The Box"

Reach 4 begins at the NM Highway 4 culvert. The survey of this reach started on July 31, 2001 and continued through this same date. This reach begins at 7947' above sea level (T18N R3E S2) and continues up into the Jemez Mountains for 1.01 miles where it stops at the beginning of "The Box" at 7955' elevation (T18N R3E S1). The average gradient for this reach is 0.15%. The Rosgen channel type for this reach is a C type channel. The stream substrate is dominated by sand and gravel.

This reach receives heavy fishing pressure. New Mexico Department of Fish and Game regularly stocks. This area is also a heavy recreational use area. During the survey, several campsites were seen near the stream. Around these campsites the vegetation had been destroyed leaving patches of bare ground or the entire area was "browned out". A small section of this reach passes through the VCNP. There are several dispersed trails that run along both sides of the stream. These trails are creating areas of bank erosion and stream widening. There were large amounts of garbage in the stream and along the banks.

The riparian community for Reach 4 consists mainly of various grass species. There were some individual dogwood trees, along with some willow and alder. The overstory is dominated by ponderosa pine, with some Douglas-fir.

Brown trout were observed during the survey as well as rainbow trout and cutbows. In Reach 4 juvenile suckers were observed in some of the side channel habitats. It is likely that the native fish assemblage is found in this reach, except for Rio Grande cutthroat trout.

Table 33. Water temperatures calculated from grab samples in Reach 4.

Reach	Max. Temp	Avg. Temp	Min. Temp
4	66	65	64

There is no thermograph data associated with Reach 4, so there is no definitive water temperature data to compare to state and forest water quality guidelines. During the survey, grab temperatures were taken throughout the day. It was determined from these grab samples that the overall maximum temperature for Reach 4 during the survey was 66º F, the average temperature was 65º F, and the minimum temperature was 64º F. All three temperatures meet the preferred range of <64-70º F for RGCT.

Habitat Characteristics

During the habitat survey conducted on Reach 4, the river was broken up into a total of 23 NSOs, measuring 5329 feet in length. Of the 23 NSOs, approximately 30% were pools. However, these 7 pools comprised only 14.1% of the stream habitat for the entire reach, 10 riffles accounted for 79.6% of the stream habitat. There is over five times as much riffle habitat in this reach as there is pool habitat. Side channels make up a very small part, 4.2% of the stream habitat. The lack of pool and side channel habitat can be

attributed to the lack of LWD, the low gradient, and the high amount of sand throughout the reach.

Table 34. Overall Stream Summary for Reach 4.

Reach 4					
Stream Length Surveyed:	5329 feet		1.01 miles		
Gradient:	0.15		**Rosgen Channel Type:**	C4	
Habitat Type	**Total Number**	**Total Feet Of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	7	786	14.8	14.1	>30%
Riffle	10	4425	83.0	79.6	-
Culvert	1	118	2.2	2.1	-
Tributary	0	-	-	-	-
Falls	0	0	0	0	-
Side Channel	5	230	-	4.2	-
Total	23	5559	100.0	100.0	-

When compared to the matrix of factors and indicators of stream health condition for historic and occupied Rio Grande cutthroat trout streams, Reach 4, is **not properly functioning** for average sediment in riffles and pool quantity.

Table 35. Summary of Habitat and Substrate Percentages for Riffles in Reach 4.

Riffle Habitat Summary						
Reach	# Riffles	Avg. Length	Avg. Width	Avg. Depth	Avg. Max. Depth	
4	10	402.3	17.0	0.9	2.5	
Substrate Summary						
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
4	29.1	44.6	18.2	2.7	5.5	100.0
Properly Functioning Indicators	<20.0	-	-	-	-	-

Riffles in Reach 4 are **not properly functioning** for average sediment amounts, with 29.1% fines (sand, silt, and clay), which exceeds the <20% criteria. The riffles are dominated by gravel, however, the amount of sand was probably greater than this percentage. It is common during surveys for observers to overlook the amount of sand found in the bankfull width of the stream. A large percent of the riffles in Reach 4 are long, deep, slow moving riffles, called glides. It is concluded that a large portion of the pool habitat was lost in this reach due to siltation. The high amount of sand found in th

Table 36. Summary of Pool Habitat and Substrate Percentages in Reach 4.

Pool Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
4	7	112.3	32.1	3.8	0.7	3.1	6.9	7	6.9	6	5.9
Properly Functioning Indicators	-	-	-	-	-	>1'		-	-	-	-

Substrate Summary							
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total	
4	47.2	28.6	12.9	0	11.4	100.0	

Reach 4 was **properly functioning** for pool quality, with an average residual pool depth of 3.1', which exceeds the minimum of >1' for a properly functioning stream. Overall the average pool was of adequate quality, but the amount of pool habitat in Reach 4 was below acceptable levels. However, the dominant substrate in pools was sand, making up 47.2% of the substrate. Due to this observation, it can be determined that the pools within this reach have begun to fill in with fines. These fines are being transported from an upstream source, and the VCNP is the primary sediment source for the stream. Reach 4 was **not properly functioning** for pool formation, with the amount of pool habitat of 14.1%, which is well below the necessary level of ≥30% pool habitat for a properly functioning stream. A typical "C" type channel should have more pools than Reach 4 has.

Table 37. Habitat Characteristics for the Reach 4.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
4	1:1.6	17:1	16.83	721	6.8
Properly Functioning Indicators	-	-	>30	-	<10

Reach 4 is **at risk** for LWD, with 16.83 pieces per mile, which is well below the necessary >30 pieces per mile necessary for a properly functioning stream. The lack of LWD in this reach can be attributed to two factors. First, fire suppression practices have reduced the amount of LWD recruited into the stream channel. Fire ecology is an important part of the landscape in New Mexico. Large fires would remove the understory, and open up the canopy for ponderosa pine, the dominant species in this reach. Fires assist in LWD recruitment for stream in this region. The dying trees would eventually fall into the stream channel. The stream would then move the LWD during floods to places where the wood could create habitat. The lack of major fires over the last century has greatly diminished the amount of LWD in New Mexico streams. Another factor in the reduced amount of LWD in this reach is due to Reach 5, which is a

bottlenecked bedrock canyon, capturing most of the LWD transported through the upper watershed.

The bankfull width-to-depth ratio for Reach 4 is 17:1, well within the necessary range of 12-30 for a "C" Type channel. Therefore, Reach 4 is **properly functioning** for criterion for width-to-depth ratio.

Reach 4 is a candidate for restoration. The heavy recreational use has degraded the riparian areas, as well as the stream itself. The numerous dispersed trails, especially near the river, have created sediment inputs to the stream. The trails have also caused soil compaction, which prevents riparian vegetation from re-establishing in these areas as well as stream widening. Many of the dispersed campsites can be found in the floodplain, and have created similar problems to the riparian vegetation. These areas have been totally "browned out" (no vegetation in the campsites due to soil compaction).

Dispersed trails along the East Fork Jemez River should be closed off and rehabilitated to promote riparian vegetation growth. The hikers should be using one trail along the entire East Fork Jemez River with an established alternative riverside trail in high use areas. Educational signs should be placed to inform people about the importance of riparian vegetation and healthy streams.

Photo 15. Reach 4, NSO 249, R106. One of the logjams recorded in Reach 4. Notice the lack of woody riparian species along the banks.

Dispersed campsites should also be closed off, and rehabilitated, and this section of stream should be managed as day use only. Riparian vegetation should be reestablished to restore proper functions to the riparian ecosystem. An educational sign should be

placed at trailheads, as well as the closed campsites. A person should patrol these areas informing the public about the pr

Reach 5: The Box

Reach 5 begins at the start of "The Box". The survey of this reach started on August 6th and ended on August 13, 2001. This reach begins at 7955' above sea level (T18N R3E S1) and continues upstream for 1.98 miles where it stops at the end of "The Box" (T18N R4E S6) near where trail #137 drops down off the ridge top at 8310' elevation. The average gradient for Reach 5 is 3.39%. The Rosgen channel type for this reach is a B1 channel type. Bedrock features dominate the substrate.

The stream increases in gradient from the last reach as it flows through a narrow bedrock canyon, locally known as "The Box". Bedrock features dominate this reach. There are numerous bedrock falls and chutes in this reach, a total of 37; whereas for the remainder of the river there were only 3 of these features. There are steep bedrock walls on both sides of the stream throughout the reach. The upper and lower sections of this reach receive recreational use; whereas, the majority of the reach is virtually inaccessible. The lower section is a common destination throughout the summer. The numerous pools in this area make it an excellent swimming area. The rock faces on both sides of the stream provide a place for people to jump off into the water; some of the cliffs are 50'. This area is locally known as "The Jumping Off Point". During the survey, at least 12 people were observed using this area. The center section of Reach 5 was virtually untouched. A small dispersed trail was observed through the section, but Trail# 137 runs along the ridge top away from the canyon. There were many fall complexes in this reach that were definite barriers to upstream migration. These barriers would make excellent places to extend the range of RGCT and remove non-native fish.

The riparian community for Reach 5 consists mainly of grasses, with an abundance of aquatic vegetation in the stream. There were some sporadic populations of willows. The majority of the riparian area in this reach consists of bedrock outcroppings with mosses and lichens observed above bankfull depth. The overstory consists of ponderosa pine with sporadic Douglas-fir populations.

Brown trout were observed during the survey. It is likely that the native fish assemblage is found in this reach, except for Rio Grande cutthroat trout, as well as rainbow trout and cutbows.

Table 38. Water temperatures calculated from grab samples in Reach 5.

Reach	Max. Temp	Avg. Temp	Min. Temp
5	63	61.6	60

There is no thermograph data associated with Reach 5, so there is no definitive water temperature data to compare to state and forest water quality guidelines. During the survey, grab temperatures were taken throughout the day. It was determined from these grab samples that the overall maximum temperature for Reach 5 during the survey was 63º F, the average temperature was 61.6º F, and the minimum temperature was 60º F. All three temperatures meet the preferred range of <64-70º F for RGCT.

Habitat Characteristics

Table 39. Overall Stream Summary for Reach 5.

Reach 5					
Stream Length Surveyed:		10457 feet		1.98 miles	
Gradient:	3.39		**Rosgen Channel Type:**	B1	
Habitat Type	**Total Number**	**Total Feet Of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	47	2868	27.4	26.8	>30%
Riffle	45	6472	61.9	60.4	-
Culvert	0	0	0	0	-
Tributary	0	-	-	-	-
Falls	37	1117	10.7	10.5	-
Side Channel	7	250	-	2.3	-
Total	136	10707	100.0	100.0	-

During the habitat survey conducted on Reach 5, the river was broken up into a total of 136 NSOs, measuring 10,457 feet in length. Of the 136 NSOs, approximately 35% were pools. However, these 47 pools comprised only 26.8% of the stream habitat for the entire reach, 45 riffles accounted for 60.4% of the stream habitat. There is over 2 times as much riffle habitat in this reach as there is pool habitat. Side channels make up a very small part, 2.3%, of the stream habitat. Pool and side channel volume is defined by the high gradient and the large quantity of bedrock canyon walls throughout the reach; thus are within the natural range ofa

Reach 4 are short, fast moving riffles, which flow over bedrock. Reach 5 is a medium gradient reach, and because of the velocity of the stream flow, this reach is not conducive for the settlement of fine substrates. Sand is typically collected in reaches with a gradient as low as the gradient found in Reach 4.

Table 41. Summary of Pool Habitat and Substrate Percentages in Reach 5.

Pool Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
5	47	61.0	23.7	3.9	0.6	3.3	23.7	46	23.2	32	16.2
Properly Functioning Indicators	-	-	-	-	-	>1'		-	-	-	-

Substrate Summary							
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total	
5	19.1	14.0	6.5	13	47.4	100.0	

Reach 5 was **properly functioning** for pool quality, with an average residual pool depth of 3.3', which exceeds the minimum of >1' for a properly functioning stream. Overall the average pool was of adequate quality, but the amount of pool habitat in Reach 5 was below acceptable levels. Reach 5 was not properly functioning for pool formation, with the amount of pool habitat of 26.8%, which is below the necessary level of ≥30% pool habitat for a properly functioning stream. Due to the numerous bedrock features within this confined reach, Reach 5 should be considered **properly functioning** for pool formation, since it is within the range of natural variability.

Table 42. Habitat Characteristics for the Reach 5.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
5	1:1	21:1	22.2	165	0.8
Properly Functioning Indicators	-	-	>30	-	<10

Reach 5 is **at risk** for LWD, with 22.2 pieces per mile, which is well below the necessary >30 pieces per mile necessary for a properly functioning stream. Though the numbers of LWD per mile do not meet the necessary requirements, the amount of LWD in Reach 5 is adequate for it to be considered **properly functioning**, since it is within the range of natural variability.

The bankfull width-to-depth ratio for Reach 5 is 21:1, well within the necessary range of 12-30 for a "B" Type channel. Therefore, Reach 5 is **properly functioning** for criterion for width to-depth-ratio.

Photo 16. Reach 5, NSO 292-294. One of the falls complexes that would make an excellent upstream migration barrier.

Photo 17. Reach 5, NSO 335. One of the 37 falls and chutes found in this reach, as well as typical bedrock features.

The stream bank condition for Reach 5 is **properly functioning**, with 0.8% unstable banks.

There are few recommendations for Reach 5. Reducing the dam

Reach 6: From the End of "The Box" to the beginning of Valle Grande

Reach 6 begins at the top of "The Box". The survey of this reach started on August 13th and continued through August 28, 2001. This reach begins at 8310' above sea level (T18N R4E S6) and continues upstream through Forest Service and private property, into the VCNP for 4.82 miles, where it stops at the entrance to Valle Grande at 8475' elevation. The average gradient for this reach is 0.65%. The Rosgen channel type for this reach is a type C channel. The stream substrate is dominated by sand substrate.

85.5% of the reach is made up riffles and glides, averaging 477' long, with very little pool habitat, 9.0%. The stream passes through a mix of meadows and densely forested areas in this reach. Along the edge of the floodplain, the bedrock features seen in Reach 6 continue, though they do not confine the stream as in the previous reach. Large quantities of alga and aquatic vegetation were observed. This may be due to the shallow depths, as about 86% of the stream has an average depth of 1. The lack of radiant cover and elevated stream temps cause the algal blooms. This reach also receives heavy recreational use as well as grazing pressure.

Reach 6 was the only reach surveyed that had any active grazing activity on it. The grazing occurred on the Santa Fe National Forest as well as private land. The recreational use was all on the Santa Fe National Forest. The recreational use primarily centered on Trail #137 and the dispersed campsites around the area even though this area is designated as day use only. Another recreational use is rock climbing. Many people used the bedrock features for climbing. Several routes could be seen up the rock faces, with the equipment left there for future use. Reach 6 possessed the only historic beaver meadow site surveyed. There may have been more in the past, but they were not easily identified. Reach 6 possessed the first tributaries above the falls. Two out of the three found in this reach contributed cooler water to the river. Tributary #4 was 63° F (one degree cooler than the mainstem); however, this tributary had very little riparian vegetation and was likely warmed due to solar heating. Tributary #5 was 61° F (six degrees cooler than the mainstem). This tributary entered at Las Conchas Fishing Area, and was lined with willows. Above Las Conchas Fishing Area, the stream enters a small canyon. The stream is more confined here, but the canyon is approximately a quarter to half a mile in length. There was no gradient change observed in this section, so the reach was not broken at the entrance to this canyon. Above the canyon, the river opens up into a meadow system again. The meadow system alternated with small patches of conifer dominant forest. These areas historically were dominated by aspen groves. Due to past grazing and fire suppression practices, the aspens have disappeared from many meadow areas around northern New Mexico. The stream then enters the VCNP through an area called "Hidden Valley".

Some stream improvement structures were found in Reach 6. In the lower section from "The Box" to Las Conchas Trailhead, approximately 12 gabions were observed in the channel. These gabions were preventing the stream to move throughout its floodplain. The majority of the gabions were causing stream bank erosion. The gabions should be removed and possibly replaced with LWD structures. In the spring of 2001, 10 trees

were dropped into the stream to improve fish habitat at Las Conchas Fishing Area. Further upriver, above Las Conchas Fishing Area, several LWD placements were observed. These structures were implemented to prevent bank erosion, however the poor design has only increased the bank erosion in these areas. These structures should either be altered to properly function in the stream channel.

The riparian community for Reach 6 was dominated by grass species mixed with the occasional patch of conifers. Cinquefoil was observed in the lower section of this reach. Conifer species were no longer dominated by ponderosa pine, rather a mixture of spruce and fir.

Brown trout were observed during the survey. It is likely that the native fish assemblage is found in this reach, except for Rio Grande cutthroat trout, as well as rainbow trout and cutbows.

Table 43. Water temperatures calculated from grab samples in Reach 6.

Reach	Max. Temp	Avg. Temp	Min. Temp
6	64	61.2	58

During the survey, grab temperatures were taken throughout the day. It was determined from these grab samples that the overall maximum temperature for Reach 6 during the survey was 64º F, the average temperature was 61.2º F, and the minimum temperature was 58º F. All three temperatures m was0 1 Tf10.00079 Tc126C630712(was0 1 Tf10.00079 Tc162C630712

When compared to the matrix of factors and indicators of stream health condition for historic and occupied Rio Grande cutthroat trout streams, Reach 4, is **not properly functioning** for all criteria in the category of habitat characteristics and channel condition, except pool quality and width to depth ratio.

Table 45. Overall Stream Summary for Reach 6.

Reach 6					
Stream Length Surveyed:	25448 feet			4.82 miles	
Gradient:	0.65		**Rosgen Channel Type:**	C5	
Habitat Type	**Total Number**	**Total Feet Of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	27	2319	9.0	9.0	>30%
Riffle	48	22899	90	85.5	-
Culvert	2	230	1.0	0.9	-
Tributary	3	-	-	-	-
Falls	0	0	0	0	-
Side Channel	27	1230	-	4.6	-
Total	107	26678	100.0	100.0	-

Table 46. Summary of Habitat and Substrate Percentages for Riffles in Reach 6

Riffle Habitat Summary						
Reach	# Riffles	Avg. Length	Avg. Width	Avg. Depth	Avg. Max. Depth	
6	48	477.1	17.5	1.0	2.0	
Substrate Summary						
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
6	32.7	28.8	25.2	9.8	3.5	100.0
Properly Functioning Indicators	<20.0	-	-	-	-	-

The riffles are not healthy in this reach. Riffles in Reach 6 are **not properly functioning** for average sediment amounts, with 32.7% fines (sand, silt, and clay), which exceeds the <20% criteria. The riffles are dominated by sand. A large percent of the riffles in Reach 6 are long, deep, slow moving riffles, called glides. It is concluded that a large portion of the pool habitat was lost in this reach due to siltation. These glides were pools at one time, but due to the high amount of fines in the system, the pools have filled in to form glides. The high amount of fine sediments found in this reach is being carried downriver from the VCNP. The VCNP is the only sediment source upstream of this reach. Reach 4 is a low gradient reach, and because of the velocity of the stream flow, this reach is conducive for the settlement of fine substrates. Sand is typically collected in reaches with a gradient as low as the gradient found in Reach 4. The siltation problem is exacerbated by the numerous dispersed trails throughout the floodplain.

Table 47. Summary of Pool Habitat and Substrate Percentages in Reach 6.

Pool Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
6	27	85.9	22.2	2.9	0.6	2.3	5.6	26	5.4	8	1.7
Properly Functioning Indicators	-	-	-	-	-	>1'		-	-	-	-

Substrate Summary							
	Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
	6	32.3	27.7	19.6	12.7	7.7	100.0

Reach 6 was **properly functioning** for pool quality, with an average residual pool depth of 2.3', which exceeds the minimum of >1' for a properly functioning stream. Although, this is a significant decrease when compared to downstream reaches such as Reach 4, indicating that pools are filling in. Overall the average pool was of adequate quality, but the amount of pool habitat in Reach 6 was below acceptable levels. Reach 6 was **not properly functioning** for pool formation, with the amount of pool habitat of 9.0%, which is well below the necessary level of ≥30% pool habitat for a properly functioning stream. A typical "C" type channel should have more pools than Reach 6 has.

Table 48. Habitat Characteristics for the Reach 6.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
6	1:1.8	19:1	11.0	4123	16.2
Properly Functioning Indicators	-	-	>30	-	<10

An additional reason for the lack of pool habitat in Reach 6 is due to the lack of LWD. Reach 6 is **not properly functioning** for LWD, with 11.0 pieces per mile, which is well below the necessary >30 pieces per mile. The lack of LWD in this reach can be attributed to two factors. First, fire suppression practices have reduced the amount of LWD recruited into the stream channel. Fire ecology is an important part of the landscape in New Mexico. Large fires would remove the understory, and open up the canopy for ponderosa pine, the dominant species in this reach. Fires assist in LWD recruitment for stream in this region. The dying trees would eventually fall into the stream channel. The stream would then move the LWD during floods to places where the wood could create habitat. The lack of major fires over the last century has greatly diminished the amount of LWD in New Mexico streams. Another factor in the amount of LWD in Reach 6 is due to the accessibility of the reach. LWD was commonly removed in the past. The access to this reach would make it a candidate for LWD removals in the past.

The bankfull width-to-depth ratio for Reach 6 is 19:1, well within the necessary range of 12-30 for a "C" Type channel. Therefore, Reach 4 is **properly functioning** for criterion for width-to-depth ratio.

It is recommended that LWD be added to Reach 6. The access for this reach is adequate enough that LWD placements would be feasible. The addition of LWD would help to increase pool quantities and depth throughout the reach. There are areas where the river flows through a forested riparian area, so LWD recruitment would have been possible in this reach. Another recommendation is to plant willows and alders along the stream banks throughout the reach. The addition of riparian vegetation would increase stream shading, decrease water temperatures, stabilize banks throughout, and allow the stream to function naturally. Stabilizing the banks would aid in reducing the sediment input to the stream, reducing the amount of fine sediments present in riffles. There are very few dispersed trails in this reach, but the dispersed trails need to be rehabilitated. Directing the impact of hiking onto one trail would decrease the soil compaction along the stream, and increase riparian growth as well. Cinquefoil was found in the lower section of the reach. This plant species is found in dry sites. However, it was present in the riparian areas. This shows that the riparian areas are being converted to dry sites due to soil compaction and vegetation loss. This conversion reduces riparian functions and stream health.

Photo 18. Reach 6, NSO 449, R180. One of the 7 log bridges encountered in this reach. Notice the large amounts of sand present and the lack of woody riparian vegetation.

The dispersed campsites should be rehabilitated as well. There were many areas where the campsites had removed all vegetation in these areas, further adding sediment to the stream. Rehabilitating some of the sites, and informing the public as to why the sites

were closed would be a benefit to the stream system. Making this reach a day use only area would help limit the amount of traffic that the stream receives.

Reach 7: From Valle Grande to Confluence with Jaramillo Creek.

Reach 7 begins at the entrance to Valle Grande on the VCNP. The survey of this reach began on August 28th and continued through August 30, 2001. This reach begins at 8475' above sea level and continues through Valle Grande for 3.7 miles until the confluence with Jaramillo Creek at 8485' elevation. The average gradient for Reach 7 is 0.05%. The Rosgen channel type for this reach is E6. Due to the large amount of bank erosion occurring in this reach, the channel is converting to a C6 channel. The stream substrate is dominated by mud.

From the entrance to Valle Grande the stream runs through a meadow system. The stream function is controlled by its low gradient and high sinuosity. However, due to historic amounts of heavy grazing streambank erosion is extremely high. On every bend in the stream, there is erosion occurring on the outside of the bend, where it should actually be undercutting. The stream was very muddy in these areas, making it difficult to walk through. Large amounts of aquatic vegetation were associated with these erosional areas. The vegetation collected fine sediment, and below the vegetation, the substrate was extremely muddy, sometimes 1-2' deep. This area at one time had deep undercut banks that provided fish with quality habitat, as well as shading the stream, keeping the water temperatures low. Now since the undercut banks are sloughing off into the stream, it has become shallower, warmer, straighter, and habitat poor. Throughout most of Reach 7, very few fish were observed. The occasional brown trout was observed, however, these fish were quite large, 18-20" on the average. Above the bridge, NMED reported catching 2 fathead minnows, 58 longnose dace, 49 Rio Grande suckers, and 87 Rio Grande chub, and no brown trout.

There were four tributaries identified in Reach 7. Two of these were streams, and one was a seep. One of the tributaries was just noted. No data was collected for this. The lack of data is due to observer/recorder error. Of the two flowing tributaries, one was La Jara Creek, and the other was an unnamed tributary. La Jara Creek, NSO 527, tributary #9, was the same temperature as the mainstem at 62ºF, though this is below a pond, where the water temp probably rises. La Jara was observed as contributing 15% of stream flow. Jaramillo Creek (NSO 530, T10) was warmer than the mainstem at 59ºF compared to 58ºF of the mainstem. Jaramillo Creek contributes approximately 50% of the stream flow to the East Fork Jemez River. There were many wetland areas along the stream throughout this reach. The stream tended to become much wider where these streamside wetlands occurred.

The riparian community for Reach 7 consists of grass species. No woody vegetation was found once entering Valle Grande. However, historically this area was probably lush with willow species. During a survey during the summer of 2001, the National Riparian Team found remnants of Bebb's Willow in neighboring Jaramillo Creek, the main tributary and reach break in Valle Grande.

Brown trout were observed during the survey as well as rainbow trout and cutbows. In the section of Reach 7 around the bridge, several large brown trout were observed,

averaging in the 18-20” size range. NMED while conducting an electrofishing survey found Rio Grande chub, longnose dace, fathead minnow, and Rio Grande suckers above the bridge. It is likely that the native fish assemblage is found in this reach, except for Rio Grande cutthroat trout.

Table 49. Water temperatures calculated from grab samples in Reach 7.

Reach	Max. Temp	Avg. Temp	Min. Temp
7	63	61	56

There is no thermograph data associated with Reach 7, so there is no definitive water temperature data to compare to state and forest water quality guidelines. During the survey, grab temperatures were taken throughout the day. It was determined from these

egeab tem

widening and shallowing, extreme bank erosion, and the deposition of sand and silt throughout the reach.

When compared to the matrix of factors and indicators of stream health condition for historic and occupied Rio Grande cutthroat trout streams, Reach 4, is **not properly functioning** for all criteria in the category of habitat characteristics and channel condition, except pool quality.

Table 51. Summary of Habitat and Substrate Percentages for Riffles in Reach 7.

Riffle Habitat Summary						
Reach	# Riffles	Avg. Length	Avg. Width	Avg. Depth	Avg. Max. Depth	
7	11	1677	14.2	1.2	2.2	
Substrate Summary						

Meadow reaches, like Reach 7, typically have undercut banks on both sides of the stream. These undercut banks provide quality fish habitat, and shade the stream. Grazing the vegetation along the stream banks has caused the undercut banks to slough off into the river, adding fine sediments to the stream, and widening the stream. These fine sediments have filled the pools throughout this reach with silt, choking off quality fish habitat.

Reach 7 was **properly functioning** for pool quality, with an average residual pool depth of 2.5', which exceeds the minimum of >1' for a properly functioning stream. Overall the average pool was of adequate quality, but the amount of pool habitat in Reach 7 was below acceptable levels, this is a significant decrease when compared to downstream reaches such as Reach 4, indicating that pools are filling in. Reach 7 was **not properly functioning** for pool formation, with the amount of pool habitat of 5.4%, which is well below the necessary level of ≥30% pool habitat for a properly functioning stream. A typical "E" type channel should have more pools than Reach 7 has. However, due to the erosion occurring in the stream channel and loss of undercut banks, the pool habitat is greatly decreased.

Table 53. Habitat Characteristics for the Reach 7.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
7	1:1.7	14:1	0[1]	8113	20.7
Properly Functioning Indicators	-	-	>30	-	<10

[1] LWD was omitted from analysis, as Reach 7 is a meadow reach.

The amount of LWD does not apply to Reach 7, as it is a meadow system. LWD would not occur in this reach, as there is no wood to fall into the channel. However, historically there may have been willows growing along the banks of the river. These willows would have provided some source of woody debris to the stream.

The bankfull width-to-depth ratio for Reach 7 is 14:1, exceeding the necessary range of <12 for an "E" Type channel. Therefore, Reach 7 is **not properly functioning** for criterion for width-to-depth ratio, showing that it is evolving into a "C" type channel.

Reach 7 corresponds to PFC segments 6, 7, & 8 (Watershed Condition Summer of 2000, McWilliams, 2000). The fisheries program recommends improvement to current riparian conditions, which according to PFC is at an upward trend. There are several ways to accomplish this, which may include but is not limited to: 1) Minimal livestock utilization of riparian areas through the use of a range rider; 2) developing elk management strategies; 3) planting and/or seeding of native vegetation; 4) incorporating prescribed fire through the meadows to promote growth of the dormant seed bank; 5) improved road management which would include properly decommissioning unneeded roads and improving road grade and crossings; and 6) further improving and developing upland water developments to spread out and further limit riparian utilization.

Photo 19. Reach 8 NSO 509. Heavy bank erosion on the left bank (outside of the bend). Notice how shallow and wide this area is, as well as large quantities of fine sediments.

Native riparian species could be planted in the riparian area. The planted species could be placed in protective tubes to prevent browsing from elk and cattle. On Comanche Creek, in the Valle Vidal, willows have come back naturally in areas that are protected from grazing. However, a range rider would be necessary to keep cattle from browsing heavily upon the riparian vegetation. A healthy riparian area is necessary to keep water temperatures low, as well as stabilizing the stream banks. A healthy riparian area would also provide water storage, and an allocthonous source of nutrients for the stream invertebrates. It is recommended to burn some of these areas to promote growth of native species that have a dormant seed bank in the soil. Burning the grass areas would assist in removing non-native species, which currently persist in some areas.

Reach 8: Confluence of Jaramillo Creek to End of Survey

Reach 8 begins at the confluence with Jaramillo Creek. The survey of this reach started on September 3rd and continued through September 5, 2001. This reach begins at 8485' above sea level and continues across Valle Grande for 4.89 miles, where it stops at the end of surface water at 8523' elevation. The average gradient for Reach 8 is 0.15%. The Rosgen channel type for this reach is an E6 channel. The stream substrate is dominated by sand and silt.

Reach 8 corresponds to PFC segments 4 & 5, (McWilliams) and extends from the confluence with Jaramillo Creek. The stream continues to run through a meadow system and is very low gradient and sinuous. Along the banks are several wetland type areas. There are five side channels each measuring 100' in length tT9980 12 541.08063 Tm(0 j12 1bita(Mas09 Tw

Large amounts of aquatic vegetation are present in this reach as well. Seep and spring complexes often had exposed stagnant water, allowing acceleration of water temperatures. It is likely these complexes have been damaged through years of intensive grazing.

There were 9 tributaries found in this reach. All were either seeps or springs, there were no stream type tributaries observed. Some of the seeps were extremely warm, for instance tributary #13 (NSO 541) was measured as 70ºF, while the mainstem measured 56ºF. This temperature difference is due to a lack of stream shading combined with the stagnant water of this seep. Some of the tributaries and side channels were difficult to differentiate. Some of the observed tributaries may indeed be side channels, or vice versa. There were several wells located within this reach, and one was putting water into the stream.

The riparian community consisted entirely of grass species. No woody vegetative species were observed. Willow species may have been present in the past.

Table 54. Water temperatures calculated from grab samples in Reach 8.

Reach	Max. Temp	Avg. Temp	Min. Temp
8	64	57.4	52

There is no thermograph data associated with Reach 8, so there is no definitive water temperature data to compare to state and forest water quality guidelines. During the survey, grab temperatures were taken throughout the day. It was determined from these grab samples that the overall maximum temperature for Reach 8 during the survey was 64º F, the average temperature was 57.4º F, and the minimum temperature was 52º F. All three temperatures meet or are below the preferred range of <64-70º F for RGCT.

Habitat Characteristics

Table 55. Overall Stream Summary for Reach 8.

Reach 8					
Stream Length Surveyed:		25798 feet		4.89 miles	
Gradient:	0.15		**Rosgen Channel Type:**	E6	
Habitat Type	**Total Number**	**Total Feet Of Stream Habitat**	**% Stream Length**	**% Stream Habitat**	**Properly Functioning Indicators**
Pool	2	290	1.1	1.1	>30%
Riffle	16	25508	98.9	96.8	-
Culvert	0	0	0	0	-
Tributary	10	-	-	-	-
Falls	0	0	0	0	-
Side Channel	6	560	-	2.1	-
Total	34	26358	100.0	100.0	-

During the habitat survey conducted on Reach 8, the river was broken up into a total of 34 NSOs, measuring 25,798 feet in length. Of the 34 NSOs, approximately 6% were pools. However, these 2 pools comprised only 1.1% of the stream habitat for the entire reach, 16 riffles accounted for 96.8% of the stream habitat. There is over 96 times as much riffle habitat in this reach as there is pool habitat. Side channels make up a very small part, 2.1%, of the stream habitat. The lack of pool and side channel habitat can be attributed to the lack of channel forming events, high bank erosion, and the high amount of sand and silt throughout the reach.

When compared to the matrix of factors and indicators of stream health condition for historic and occupied Rio Grande cutthroat trout streams, Reach 8, is **not properly functioning** for all criteria in the category of habitat characteristics and channel condition, except pool quality and width-to-depth ratio.

Table 56. Summary of Habitat and Substrate Percentages for Riffles in Reach 8.

Riffle Habitat Summary						
Reach	# Riffles	Avg. Length	Avg. Width	Avg. Depth	Avg. Max. Depth	
8	16	1594	6.2	1.2	1.8	
Substrate Summary						
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total
8	61.3	35	0.6	0	0	100.0
Properly Functioning Indicators	<20.0	-	-	-	-	-

The average riffle in Reach 8 is much longer than the average riffle should be. The riffles are not healthy in this reach. Riffles in Reach 8 are **not properly functioning** for average sediment amounts, with 61.3% fines (sand, silt, and clay,), which exceeds the <20% criteria. The riffles are dominated by silt. This has limited spawning potential and productivity. A large percent of the riffles in Reach 8 are long, deep, slow moving riffles, called glides. These glides were likely pools that have filled in due to siltation. The high amount of fine sediments found in this reach is due to the bank erosion occurring throughout this reach and increased sediment inputs from upland sources. Meadow reaches, like Reach 8, typically have undercut banks on both sides of the stream. These undercut banks provide quality fish habitat, and shade the stream. Grazing the vegetation along the stream banks has caused the undercut banks to slough off into the river, adding fine sediments to the stream. These fine sediments have filled the pools throughout this reach with silt, choking off the quality fish habitat.

Table 57. Summary of Pool Habitat and Substrate Percentages in Reach 8.

Pool Habitat Summary											
Reach	# Of Pools	Avg. Length	Avg. Width	Avg. Max Depth	Avg. PTC	Avg. Residual Depth	Pools/Mile	# of Pools w/ Residual Depth >1'	Pools w/ Residual Depth >1'/Mile	# of Pools w/ Max. Depth >3'	# of Pools w/ Max. Depth >3'/Mile
8	2	145	15	2.1	0.6	1.5	0.41	2	0.41	0	0
Properly Functioning Indicators	-	-	-	-	-	>1'		-	-	-	-

Substrate Summary							
Reach	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Total	
8	65.0	35.0	0	0	0	100.0	

Reach 8 was **properly functioning** for pool quality, with an average residual pool depth of 1.5', which exceeds the minimum of >1' for a properly functioning stream. Overall the average pool was of adequate quality, but the amount of pool habitat in Reach 7 was below acceptable levels, this is a significant decrease when compared to downstream reaches such as Reach 4, indicating that pools are filling indue to bank erosion and sediment delivery from the poor road network, historic timber harvesting, and grazing practices in the upland areas. Reach 8 was **not properly functioning** for pool formation, with the amount of pool habitat of 1.1%, which is well below the necessary level of ≥30% pool habitat for a properly functioning stream. A typical "E" type channel should have more pools than Reach 8 has. However, due to the erosion occurring in the stream channel, and lack of channel forming events the pool habitat is greatly decreased. The 2 stock ponds above the terminus have exacerbated the lack of channel forming events. These ponds trap water from high spring flows as well as the summer monsoon events. This water would help flush the fines sediments out of the channel as well as contributing to pool habitat formation.

Table 58. Habitat Characteristics for the Reach 8.

Reach	Pool:Riffle Ratio	Bankfull Width: Depth	Pieces of LWD per Mile	Total Unstable Banks	Percentage of Unstable Banks
8	1:8	6:1	0[1]	3680	7.1
Properly Functioning Indicators	-	-	>30	-	<10

[1] LWD was left out of this analysis as Reach 8 is a meadow reach.

The amount of LWD does not apply to Reach 8, as it is a meadow system. LWD would not occur in this reach, as there is no wood to fall into the channel. However, historically there may have been willows growing along the banks of the river. These willows would have provided some source of woody debris to the stream.

The bankfull width-to-depth ratio for Reach 8 is 6:1, meeting the necessary range of <12 for an "E" Type channel. Therefore, Reach 8 is **properly functioning** for criterion for width-to-depth ratio.

Reach 8 corresponds to PFC segments 4 & 5 (Watershed Condition Summer of 2000, McWilliams, 2000). The fisheries program recommends improvement to current riparian conditions, which according to PFC is at an upward trend. There are several ways to accomplish this, which may include but is not limited to: 1) Minimal livestock utilization of riparian areas through the use of a range rider; 2) developing elk management strategies; 3) planting and/or seeding of native vegetation; 4) incorporating prescribed fire through the meadows to promote growth of the dormant seed bank; 5) improved road management which would include properly decommissioning unneeded roads and improving road grade and crossings; and 6) further improving and developing upland water developments to spread out and further limit riparian utilization.

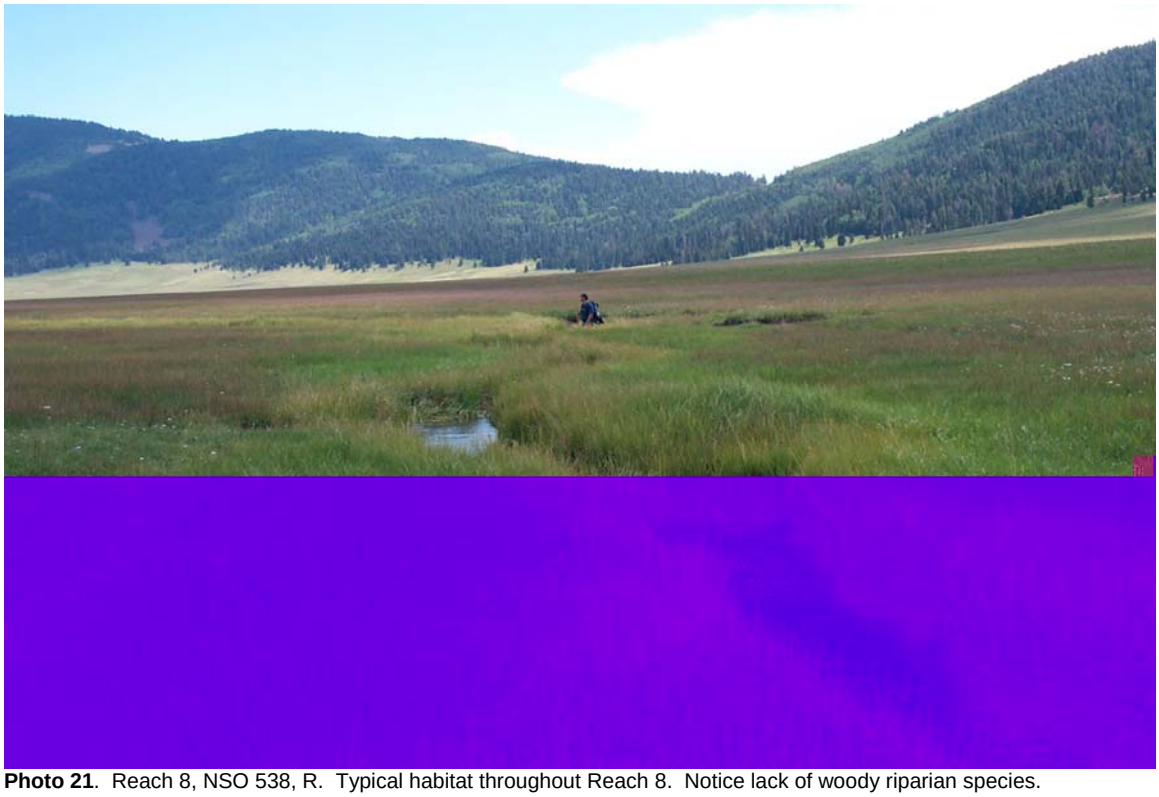


Photo 21. Reach 8, NSO 538, R. Typical habitat throughout Reach 8. Notice lack of woody riparian species.

Native riparian species could be planted in the riparian area. The planted species could be placed in protective tubes to prevent browsing from elk and cattle. On Comanche Creek, in the Valle Vidal, willows have come back naturally in areas that are protected from grazing. However, a range rider would be necessary to keep cattle from browsing heavily upon the riparian vegetation. A healthy riparian area is necessary to keep water temperatures low, as well as stabilizing the stream banks. A healthy riparian area would also provide water storage, and an allocthonous source of nutrients for the stream invertebrates. It is recommended to burn some of these areas to promote growth of native species that have a dormant seed bank in the soil. Burning the grass areas would assist in removing non-native species, which currently persist in some areas.

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